THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE

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PROCEEDINGS OF SOCIETIES.

The winter flood of technical papers is once more upon us, and bids fair to surpass all previous records for quantity; we hope that time will show that the quality is also unexcelled. With six local sections of the I.E.E. busily engaged in firing off inaugural addresses, papers, &c, in addition to the central body, the Inst. C.E., the Faraday Society, Physical Society, and numerous minor engineering societies (to say nothing of the St. Louis Congress), there never was a time when so much "free matter" was placed at the disposal of technical editors—almost forced upon them, in fact.

What are we to do with the vast accumulation of matter? Who reads it all? Were we so disposed, we could fill our columns from cover to cover with the proceedings of societies, at a cost but little beyond that of printing. Some of our contemporaries, in fact, do this to the extent of half their space. We believe, however, that we shall better fulfil the wishes of our readers by keeping a tight rein on this tendency to cheap journalism, and by restricting the space devoted to such proceedings to a reasonable extent, as has been our custom in the past. We shall be compelled to deal with many papers in very brief compass, and to give others bare mention; but by no other means can space be secured to adequately treat the many other matters of interest to our readers.

The torrent of technical literature, it must be admitted, is an extremely good thing for the engineering industry in general, for by this means, and to perhaps an equal extent by the discussions on the papers, the diffusion of useful knowledge is promoted, and the technical training of the younger members is accelerated, whilst the older members are enabled to keep their general knowledge fairly well up to date, without the vast expenditure of time in independent research otherwise necessitated.

In this connection a valuable suggestion was put forward in their angural addresses both by Mr. M. Ruddle, at Dublin, and by Mr. R. Robertson, at Glasgow, to the effect that long papers were not alone essential; short papers on matters of practical interest, on difficulties met with and the methods of overcoming them, are equally useful, and likely to lead to valuable discussions. As we have urged on previous occasions, the tendency of papers and discussions to be left in the hands of the few leading members is to be deplored, and we trust that the foregoing suggestion will be fruitful in results. The free and harmonious interchange of ideas amongst technical men is

of the greatest value in hastening progress, and it would be greatly assisted by less formality and stiffness in the meetings. It is not even essential that any formal agenda should be carried out; why should not members meet now and then purely for a chat?

Permanent-way Construction and Constituents.

Following the review of Mr. Connett's paper, in our last issue, we have to notice a paper covering much the same ground, which was read by Mr. C. T. Taylor, before the Rugby Engineering Society.

Emphasis is laid, first of all, on the vital bearing which sound construction has on the future profits, and it is taken as an axiom that £500 per mile of single-track must be put aside annually towards a renewal fund, and quite apart from allowances for maintenance and sinking fund.

The doctrine of depreciation as necessary to commercial salvation finds few better examples than this one of track renewal, and although we do not consider that the concrete bed will require anything like renewal for 20 years, if properly laid in the first instance, yet we do believe that the basis of calculation given in the paper will not be found amiss as an average basis for the whole kingdom. Practically it comes to this, that capital to the extent of £6,000 multiplied by the number of single miles of track is wiped out long before the shortest lease is up, and long before the shortest period of repayment of loans is complete. Whether the actual life of this capital is 12 years "as a generous average," or whether the average ought to be increased by 50 per cent., makes very little difference to the vast majority of tramway undertakings, whether owned by voluntary or involuntary speculators—whether owned, that is to say, by limited companies or by unlimited corporations.

In the rush of exploitation and development of the last 10 years, and more particularly of the latter half of that period, during which time nine-tenths of the men now associated with tramways have reckoned to learn their business, the depreciation of none of the organs of a tramway system has had enough consideration. All the time has been given to prising open people's cash-boxes with the infallible electric jemmy, and none has been spent on level-headed reflection on the active life of the capital extracted. This is sufficiently evident from a glance at almost any balance-sheet published even during the current year.

The sums put to depreciation account are grotesquely inadequate, and the day of reckoning will have to come sooner or later in every case. Extensive renewals may be made out of capital for a time, but that capital has to be accounted for in the end.

To return to the paper, the author remarks that higher rail lips are required on curves than on the straight, to prevent the trailing wheels mounting in their endeavour to bring the axle along a true radial line.

The average analysis given compares evenly with Mr. Cole's in last week's issue, with the exception of carbon and silicon, the latter especially being higher.

The author's experience leads him to prefer 45-ft. to 60-ft. rails, but we think the weight of modern experienced opinion is against him both here and in America. When the longer rails are made in England—and they need not be made anywhere else—the cost of carriage per ton, the cost of handling per ton, and the extra straightening on the ground, are not the serious items Mr. Taylor would have us believe, while the benefit arising from the reduction of rail joints by 25 per cent. much more than outweighs all these possible objections put together.

It is pleasing to have another expert witness say that no provision need be made for expansion in buried rails, so that the joints may be butted, the smallest opening leading to pounding, with consequent loosening of the fastenings and more pounding, but it is surprising to find nothing said of the welded joint, which seems to form a logical sequence. Instead, a particular design of mechanical joint, of which the author gives a drawing, is recommended. Undoubtedly, this joint has been successful, but it has *parts*, while the welded joint is an indivisible whole, in which nothing can shake loose, and in which there are no internal surfaces to erode by oxidation or electrolysis. The probability of either of these evils attacking the best of the mechanical joints may be remote, but that joint is the best which makes even the possibility negligible.

Fish-plate joints have been marred in time past both by the bearing surfaces of the plates being designed with too obtuse an angle, and by an insufficient number of bolts; and a "kink" well worth remembering is to knock off all the oxide scale on fresh-rolled rails, as well as the red oxide on rails which have been in stock, before putting on the fish-plates.

Many engineers have an objection to using pitch grout, because it has caused so much trouble by boiling over the paving in summer. We agree with the author that there is no better grouting material than pitch, and the trouble can be neutralised by finishing off with cement grout.

Wood paving is tricky stuff. Some men know how to lay it, and more do not. Perhaps it is wise that "a tramway engineer seldom lays it for choice."

The paper will be useful to the members, few of whom, probably, are experienced in the subject.

Brakes as Safety Devices.

Under the heading, "Safety Devices for Electric Tramways," Mr. T. W. Sheffield contributes to the current *Light Railway and Tramway Journal* an article on brakes. It is more descriptive than critical, and something is said about all the types of brake which are in general use.

An effective opening is made by proving that something more than the wheel brake is necessary if the car is to be stopped within any reasonable distance on steep grades, such as are to be found in a large number of towns through which tramways run; and the acceleration due to gravity on a grade of 1 in 10 tending to neutralise the braking force is shown on diagrams which might be understood by motormen, as it appears they are supposed to be, after considerable explanation. For our part, we have met few motormen who have any conception of the construction of a curve, nor have we expected to do so.

With a good hand brake on a level road it is possible to exert the maximum practicable pressure, *i.e.*, that limiting pressure which will skid the wheels; so that another brake acting on the wheels is redundant. The second brake, then, should be a slipper of some kind acting on the rails. When heavy grades have to be negotiated, a power brake of some kind should be used; Mr. Sheffield thinks that for this work the wheel-brake, however actuated, must give way to the track-brake, and that is a judgement with which we concur. Remove the wheel-brakes altogether, if possible, or keep them as a stand-by, or to hold the car on a hill, and rely solely on the slipper.

What slipper? Shall it be worked manually, pneumatically, or magnetically? Mr. Sheffield gives a short description of the best known electric track-brakes, but omits to mention further the pneumatic track-brake, which has been adopted on several systems both for service and for emergency. Our preference goes in the direction of the simple magnetic slipper, and we do not believe that there is any bottom at all in the dictum of more than one manager,

that "you must give a man something to pull at. Give him the job of lifting the car on the slipper-blocks, and let him pull as hard, or as long, as he likes, he can do no harm." That might have had an application once, but it is pointless now in the presence of magnetic brakes, which will not run the car into an accident however quickly they may be applied, and will avert accidents more surely than any hand-applied brake, simply because the ante-action time limit is reduced from several seconds to some small fraction of a second. The same kind of man would oppose an easily-operated brake, because the motormen would have nothing to do, and might grow fat and mutinous! We should be much interested to see "ergographs" taken on successive days from a motorman who has driven a manually-braked car on one day, and a magnetically-braked car on the next. The graphic demonstration of conserved force on the second tracing would be a striking advertisement for the magnetic brake.

The Noise of Electric Tramways.

COMPLAINT has been rife of late that the noise of electric trams is rapidly becoming a serious nuisance in residential districts. Persons who love to see themselves in print allege that the continual passage of heavy cars to and fro in front of the street door keeps them awake at night; while the continual noise of the traffic in the daytime is said to be prejudicial alike to the peaceful enjoyment of property and the sound condition of the nervous system. We are free to confess that the electric tramcar is noisy; that the cars may, at times, interfere with other traffic; and that the frontager has some right to complain. Nevertheless, we think that the law which undoubtedly protects a tramway company from actions for nuisance alleged to be caused by them in the legitimate conduct of their business, is wise and just. The electric tramcar has come to stay. It has conferred an incalculable boon upon the working classes, and not only upon the working classes, but upon thousands of others in the suburbs, who have to travel far from home to office desk. If a railway company is allowed to create noise and disturbance as the necessary result of running trains, it is obvious that a similar privilege must be conferred upon electric tramway companies.

Lightning Conductors.—At the second general meeting of the Birmingham Architectural Association, a lecture on "Lightning Conductors" was delivered by Sir Oliver Lodge. In the course of his remarks, he stated that a copper conductor was not so good as an iron one. It did not damp out the oscillations; it let the current down too suddenly and was liable to side flashes. A small iron wire was ample protection, so long as the wire lasted. The lightning might dissipate the wire, but by the time the flash was over the conductor had achieved its purpose. It was better to have a number of cheap conductors than one or two expensive ones. But if one wanted to be absolutely immune from lightning—and there were cases when it was desirable, such as in the case of a powder magazine, or a gun cotton factory—one could be so by providing a complete metallic enclosure like a banker's strong room. The only possible way to damage such a building would be for the lightning to be strong enough to melt it. The building might retain the charge, however, so that it would be as well to have sky and roof terminals. Sir Oliver then proceeded to demonstrate his lecture with a number of interesting experiments.

The Danube-Oder Elevator Competition.—It is announced that no fewer than 250 schemes from all parts of the world were submitted in the competition which was instituted by the Austrian Government in connection with the project for establishing comprehensive elevating plant in connection with the Danube-Oder Canal. Three prizes were originally offered, but the international jury to whom the consideration of the plans was entrusted have decided in favour of only two being awarded. At the final conference, over which the Austrian Minister of Commerce presided, the jury allotted the first prize to the five united machine works in Bohemia and Moravia, the Siemens-Schuckert Works Co. being associated with the scheme. The second prize was awarded to the project jointly presented by the Siemens-Schuckert Co., the Andritz Machine Works Co., Herr Ritter von Stockert, Herr W. von Offermann, and the United Machine Works Co., of Augsberg and Nuremberg. In addition to the two awards, the jury recommend the purchase of three other schemes submitted in the competition, while five are given honorable mention.

ELECTRICITY IN COTTON MILLS.

THE strides which America is making in the manufacture of cotton goods is well known; that her manufacturers are also giving their attention to electrical driving, would go without saying; and whilst we at home have not been slow to avail ourselves of new methods in this direction, nevertheless it is to be feared that the matter has not been taken up with that specialisation and concentration which obtains in America. Our cotton industry is at present going through a crisis entirely due, it is believed, to shortage of raw material; perhaps, however, we shall not be far wrong in thinking that a few new methods would not be out of place. The papers which were recently read on the above subject before the New England Cotton Manufacturers' Association are therefore of some interest, if only as showing the attention that is being given to the subject. That this is not inconsiderable is shown by Mr. Charles Robbins, who, discussing "Electricity in Textile Mills," mentions that in 1900, there was being used approximately 800,000 H.P. in 98½ per cent. of the American cotton mills, whilst there are now electric motors aggregating 140,000 H.P. in use.

Mr. Robbins lays down the following conditions for a textile mill plant: constant speed, maximum efficiency at all times for each unit of plant, minimum amount of attendance, least possible floor space, capacity for easy extension, and when so enlarged to have any or all generating units supplying power to any or all points irrespective of location of power, demand or distance. These conditions, he says, are best met by electrical transmission, and electrically-driven mills undoubtedly turn out more work, and of a better quality, than those driven by mechanical means. Tracing the steam engine from the early days of electricity to the present time, the author attributes some of the great improvements in the steam engine to the requirements of the economical generation of electricity, especially for power and traction; further, the proper running of alternators undoubtedly caused a revolution in steam engine design in order to secure parallel running. Consequently, the prime mover of to-day—the steam generator—is a far more efficient and economical unit in every way than the older fashioned Corliss type of engine, in such points as floor space, steam consumption, absence of belting, and many others apparent to everybody. An important one for textile mills is that the initial plant may consist of two units, each running economically and normally at from 70 to 75 of its rated load, and in the event of accident to one unit, the other, by reason of its overload capacity, could carry the entire demand for power during the period of repair to the first.

The consideration of direct-coupled plant leads necessarily to the steam turbine, which Mr. Robbins advocates as the ideal generator for mills. Amongst other advantages over Corliss engines, he mentions that the turbo-generator occupies only one-fifth the space, and two-thirds the height. Foundation bolts are unnecessary, with consequent saving in foundations. From 50 to 125 per cent. load, the steam consumption is a straight line; there is hardly any wear on the bearings; and the engine is practically "fool-proof." Another point in its favour is that no internal lubrication is required, and therefore the condensed steam can return direct to the boiler. A case is instanced where the cost of oil for a 600-H.P. turbine was during several years about 2½d. per day of 24 hours—or about 10 per cent. of that required for a reciprocating engine of similar capacity.

The distribution of wires for the transmission of the power costs less than belting and shafting, and that it is a system of greater flexibility, is obvious; and from this the author leads on to a consideration of the best motor to use. Here he unhesitatingly plumps for the alternating-current type, consisting as it does of only simple parts, and having automatic regulation, requiring power only in proportion to its output, and being capable of sustaining large overloads without injury. Further, the inherent design of this type of motor makes the uniform rotative speed of the prime-mover available at the work just as though it were directly coupled up.

Speaking generally, as regards breakdowns and extensions, the electrical driving of a cotton mill is security against the

completeness of the one, whilst its facilities for the other are unlimited. The author adds a few remarks in conclusion regarding electric lighting, advocating the Nernst lamp as the ideal lighting for textile mills, owing to the quality of its light, its flexibility in candle-power, and its capability of being used efficiently on 200 to 220-volt circuits. He instances many large mills as being illuminated with this lamp, but a few figures as to cost of upkeep and renewals as compared with the arc lamp would have been interesting. Some results of tests of turbo-generators are given.

The second paper, read by Mr. Edward W. Thomas, was entitled "Electric Measurements of Power required in Cotton Manufacturing," and consists chiefly of a series of most interesting tests at a certain mill, set out in tables. Unfortunately, we have not space to detail these tests, but the following is an abstract of the conditions and of the figures obtained :—

Number of motors, 24 in all, comprising 1 of 20 H.P., 1 of 30 H.P., 1 of 50 H.P., 1 of 75 H.P., and 20 of 150 H.P. The combined rating was 3,175 H.P., and the total load 2,597·33 H.P. The total amount of power required to drive the motors, shafting, &c., was 552·1 H.P., or 21·25 per cent.

In testing for spindles per horse-power on warp spinning, each motor drove 10,000 spindles. The average number per horse-power at full load, deducting friction of motor and shaft, was 80·12, compared with 65·92 spindles per horse-power, including these losses, giving a reduction in spindles per horse-power of about 18 per cent. With the filling frames the respective figures were 98·8 and 76·4 spindles per horse-power, or about 20 per cent. reduction. In the case of the looms, the average was 4·87 and 3·62 looms per horse-power respectively. The following figures of weights are interesting, bearing in mind that all the pulleys above 20 in. had wood rims, and the bays were 10 ft. 8 in. from centre to centre :—

Shafting	1·70 lbs. per spindle	
Couplings	3·09 „	„
Pulleys	1·361 „	„
Total	3·376 „	„

The percentages of total load for each department were :—

Opening and picking ...	130 H.P.	5·13 per cent.
Cards, drawing and roving	354·25 „	14 „
Spinning	1,363·70 „	53·9 „
Slashing	·26 „	1·00 „
Weaving	637 „	25·17 „
Cloth room	19·5 „	·80 „

The motors were all suspended overhead, and operated at 550 volts and 40 cycles.

The paper contains some of the charts taken by the recording wattmeters used on the tests. Each motor was given a reading for 75 minutes, the connection being made first for full load and then stepping down the load in different degrees. The author believes that every mill motor should have its own registering wattmeter, by means of which any increased power developed or of coal consumed would be immediately noticed and traced out.

ELECTRIC SIGNAL LIGHTING ON THE LANCASHIRE AND YORKSHIRE RAILWAY.

By VERAX.

The electrification of a few signal lanterns on the Lancashire and Yorkshire Railway, was first tried experimentally about six years ago at Victoria Station, Manchester, with satisfactory results. When Bolton Station was rebuilt and enlarged, it was quite in keeping with the modernised condition of this important railway centre that the signals should also be lighted by electricity.

In the Electrical Review for April 22nd, 1904, we published an account of the installation at Bolton New Station, which comprised an electro-pneumatic signalling system, together with 21 electric cranes, 17 electric capstans, 6 electric lifts, 18 electric jiggers, and 800 electric lights. The advantages of such a power plant doubtless influenced the railway officials to electrically light every signal about the place, in preference to using oil or gas.

More than 200 signals have now been provided with this kind of illuminant at Bolton, and the success attending these

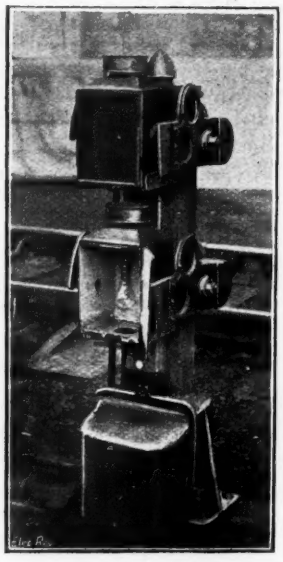


Fig. 1.—Double-Arm Dwarf Signal.

early efforts has led the railway company to carry out a similar project, though on a larger scale, in connection with the Hunt's Bank widening, outside the city of Manchester.

Our readers may remember that a brief reference was made in the article named, to the method employed by the Lancashire and Yorkshire Railway for fitting up their electric signal lamps.

Instead of securing the lamp bracket to the base of the lantern, it is fitted inside the lid by means of three springs, the combined tension of which holds the bracket firmly in position, and at the same time makes a good mechanical job. A view is given in fig. 2 of a main-line signal lantern, such as has been described, with the top partially open; but it will be understood that, as the lid is closed, the electric lamp falls to a position behind the bull's eye and back disk respectively, thus affording a front light for the engine driver and a back light for the signalman.

Fig. 2.—Main-Line Signal Lantern.

Our first illustration depicts a double-armed dwarf signal, the lantern lid for the lower arm being purposely opened to permit a view of the interior of the lantern. In case of necessity, the electrical portion could be removed in half a minute, and the value of such an arrangement will be referred to later on.

At the transition stage from oil to electricity, several filament breakages occurred where the latter are anchored to the platinum wires. These faults were traceable not to defective manufacture (as is usually the case), but to severe vibration set up when the semaphore arms were pulled off or restored to the danger positions. Acting upon the

English maxim that "difficulties were made to be overcome," this problem was duly solved by inserting a small piece of twin flexible cord 35/40 gauge between the lampholder and the bracket within the lantern lid. Filament vibration was thereby reduced to a negligible quantity, because the most delicate part was no longer rigid.

The form of bracket used at the commencement is shown in fig. 3, and the later type with flexible suspender is portrayed in fig. 4.

If incandescent lamps are subjected to a 24 hours' test at the generating station, prior to use on signals, and afterwards fixed in the manner indicated, it is safe to affirm—as the result of practical experience—that no trouble need be anticipated.

Fig. 3.—Early Form of Lamp Bracket.

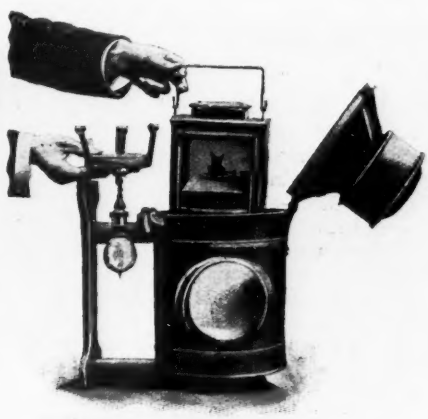


Fig. 4.—Recent Flexible Lamp Suspension.

The installation pressure at Bolton L. & Y. Rly. generating station is 220 volts, but the 8-c.p. lamps used on the signal section are made for 230-volt circuits. Two results accrue from having lamps 10 volts in excess of the working pressure, both of which are satisfactory :—

1. The filaments never become quite incandescent, and a prolonged life for the lamps may safely be predicted.

2. Light is emitted through the red and green spectacles at an intensity suitable for railway requirements.

A double-pole switch is fixed in each signal box, the signalman being held responsible for switching his own signal lights on and off at the proper time ; moreover, a pilot light is placed near the block instrument shelf, which not only tends to illuminate his cabin, but serves primarily to remind him whether his signals are lighted or not. If a fog descended or the sky became enveloped in a dense gloom during the day time, the pointsman would at once switch on current to the signal lights, and thus cope effectively with an exigency all too prevalent at this time of the year. How long, under similar atmospheric conditions, it would have taken a lampman to scale 100 ladders and light 200 gas or oil lamps is a question which we prefer to leave to the fertile imagination of our readers. Furthermore, the fog may have lifted within an hour or two of its commencement, and the lights would then require turning off again. It will be apparent to everyone familiar with railway work, that under electrical conditions it is possible to economise light in the morning and evening, owing to the fact that all signals can be instantly lighted at dusk and extinguished at twilight ; these factors indicate that electric signal lighting has come to stay.

An electrolytic meter is connected in series with the positive main, so as to register the number of B. of T. units consumed exclusively on signal lamp circuits.

The cables are laid in underground conduits, from the power house to where iron-cased branch fuse-boxes are fixed on the signals.

Beyond this point 3/22 lead-covered twin-wires are continued to the lamp terminals without additional protection. We admit that wood casing and steel tubing have advantages under certain definite conditions, but for signal lighting, lead-covered wires, carefully cleated, are undoubtedly the best. In a few instances *three* lamps have been joined in parallel to one set of fuses, but by far the greater number are wired for a maximum of *two* lights per fuse ; whence it will be obvious that a broken filament only affects one semaphore signal, whereas a short-circuit in a lampholder would blow the fuse and extinguish two lamps.

An idea has somehow got abroad that, if a signal light became extinguished, the probability of a railway accident would be very great, and the question is occasionally asked : "What would happen if a light went 'out ?'" Well, the railway company have a lineman on duty, a small portion of whose time is devoted to maintenance work of this kind. In practice, a blown sub-fuse, or a defective lamp is the type of fault met with, as our technical readers will readily understand.

The pointsman or shunter may be the first to notice a failure, in which case the defect would be promptly notified by telephone to the power station and quickly remedied. But if, in the meantime, a passenger train approached, what then ? In that case the engine driver would carry out the rules and regulations of the railway company, which instruct him to treat a light "out" as a danger signal, bring his train to a stand, and report the fact to the signalman or station master. The passengers would necessarily suffer a few minutes' delay, but after the usual precautions had been taken, the train would be allowed to proceed on its journey.

Let us suppose for a moment that *all* the lights had failed. This is a very remote possibility, but if such a mishap did occur the difficulty would be temporarily overcome in the manner illustrated in figs. 3 and 4. The electric brackets would be quickly replaced by paraffin lamps until permanent repairs could be effected : needless to say, the first total failure has yet to be recorded.

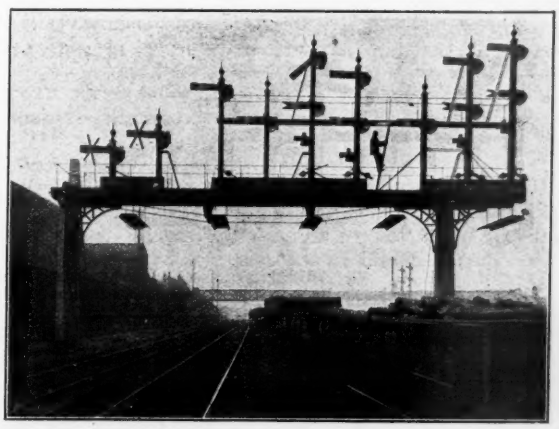


Fig. 5.—Electrically-Lighted Bridge of Signals.

In the North of England, tunnels and bridges invariably span the approaches to our large stations, and these obstructions render signal sighting a somewhat perplexing task.

Now the semaphores on a bridge of signals, such as may be observed in fig. 5, have to be superposed so that an engine driver may observe the "Home" signal con-

trolling the particular line he is travelling along before he emerges from the tunnel.

The murky surroundings, however, render it imperative that the signals shall be illuminated several hours longer than those which have a clear, sky-line background. An 8-ampere tumbler switch is therefore employed in special cases of this sort and manipulated as required.

Some of our Continental *confrères* have two lamps burning in parallel, lest one should fail; others have adopted a more ingenious arrangement, whereby a warning bell is rung when the filament breaks, a second lamp coming automatically into action. Either of these methods would be costly and fraught with difficulties at a station where there are so many lamps as the installation described.

Sufficient, however, has been said to show the trend of events on the Lancashire and Yorkshire Railway in the matter of signal lighting.

AMSTERDAM—HAARLEM ELECTRIC TRAMWAYS.

Last week-end, by the courtesy of Messrs. J. G. White and Co., the contractors, we shared in a visit of inspection to the above-named tramways. They are the property of the Electrische Spoorweg Maatschappij, of Haarlem, and embrace, besides the line from Amsterdam to Haarlem—an entirely new construction of the light railway order, about 12 miles in length—an older tramway from Haarlem to Zandvoort, an extremely popular seaside resort. The last-mentioned undertaking originally belonged to the Eerste-Nederlandsche Electrische Tramways, the first electric tramway installed in the Netherlands; the E.S.M. company, which was partly financed from New York (the New Amsterdam of a byegone era), acquired a controlling interest in the E.N.E.T., partly reconstructed and doubled the track, and built new car-sheds, &c.

The unique feature of the new Amsterdam—Haarlem section is the fact that the tracks, which are on either side of the great military road constructed by Napoleon, and run parallel with a canal and a railway, are held up throughout their entire length by sheet piling, necessitated by the sandy nature of the soil. The company has secured running powers over the municipal tramways to the centre of Amsterdam. The total cost of the work, including track construction, rolling stock, power station and car-sheds, has amounted roughly to £300,000.

On Saturday the visitors were taken over the routes by Mr. A. N. Connett, chief engineer to Messrs. J. G. White and Co., to whose designs the work has been carried out; they were accompanied by Mr. Wood, who has had charge of the construction, Mr. C. H. Julius, engineer and manager of the E. S. M., and Mr. Murphy, of Messrs. J. G. White & Co.'s London engineering staff.

On the following day a visit was paid to the new municipal electric lighting and traction generating station in Amsterdam.

The party was greatly interested in the various engineering works visited, as well as in the unique system of canals for which the City of Amsterdam is famed, and the numerous other features of interest characteristic of that ancient city. Thanks to the lavish hospitality of Messrs. J. G. White & Co., the tour was in every way enjoyable, and the visitors were especially indebted to the four gentlemen above-named for their successful efforts to ensure the comfort and entertainment of their guests, who returned to London on Monday morning. A full account of the tramways will appear in a later issue.

INSTITUTION OF ELECTRICAL ENGINEERS.

On Thursday, November 17th, Mr. W. Emmott, chairman of the Leeds Local Section, delivered his inaugural address, which was devoted mainly to a review of the electrical industries. The chairman referred briefly to the depression in trade during 1903, the standardisation of materials, the new patent regulations, &c. He considered that the Post Office was the proper authority to deal with the whole of the public telephone work of this country, and ought to acquire the National Telephone Co.'s system at a fair price. In electric lighting and power work, the chairman thought the gas engine would have a great future, and that the suction type of gas plant would be largely adopted; his experience with engines of 300 B.H.P. had been very satisfactory. For small stations the gas-driven plant had special advantages, and might be worked in conjunction with a municipal supply of power gas.

The section had done well during its first year, thanks largely to the labours of the hon. secretary, Mr. G. R. Blackburn, and with the cordial co-operation of the members it might count upon a prosperous future.

Gas Engines for Central Stations.

Abstract of Paper read by Hugh Campbell, M.Inst M.E., at Leeds, on Thursday, November 17th, 1904.

It may truly be said that from engineers the gas engine maker has received less encouragement and support than from any other branch of industry.

The gas engine has been less used for public electric supplies than for any other work that I know of. I suppose the reason for this in the past has been the doubt as to whether the gas engine possessed the qualities of developing its rated power continuously, with economy, running with regularity and reliability.

The first central station of any size adopting gas engine power was the City of Belfast, which erected in 1895 a station consisting of four horizontal double-acting engines each of 120 I.H.P., and two double-acting engines each of 60 I.H.P.

The cost of production of the current, as given by Mr. Victor A. H. McCowen, electrical engineer to the Belfast Corporation, from a paper read before the Institution of Mechanical Engineers in July, 1896, was 5·417d. per unit sold, on an output of 82,771 units from January 23rd to December 31st, 1895.

The gas engine plant was a failure, and has since been replaced by steam engines, the cause of this being no doubt the extraordinarily heavy cost of production, as well as trouble with the plant.

Several other stations have, during the last few years, been set to work with gas engines, of which data follow:—

Later Gas-Driven Stations.

—	Units per annum.	Load factor.	Fuel cost per unit.	Oil, waste, and water.	Wages.	Repairs.	Total works cost.
			d.	d.	d.	d.	d.
Walthamstow...	814,187	15·45	·46	·19	·36	·06	1·07*
Redditch ...	265,717	14·11	·88	·19	·53	·24	1·84
Northwich ...	157,198	9·20	·51	·15	·50	·35	1·51†
Averages...	—	14·38	·555	·184	·413	·135	1·29

* Anthacite coal, 26s. per ton in bunkers. † Mond gas, 2d. per 1,000 ft.

From these figures you will see what an enormous improvement has taken place in the economical production of electricity in these stations, as compared with that of Belfast.

I now come to some more recent installations of gas engines for central station work, those in which my firm has been responsible for the engines. In one of these, viz., that of the Guernsey Electricity Co., there existed prior to the installation of the gas engines a steam-driven plant of practically the same output as the gas engine plant which was installed later.

The stations are equally favourably situated with regard to the coalfield, and the cost of carriage on the coal is the same.

St. Peterport Steam-Driven Station.

One battery 32 KW. Capacity 10 hours.
Two 75-KW. combined steam engine sets.
Two 180-KW. triple-expansion steam engine sets.
One condenser 360 KW. capacity.
Two water-tube boilers and superheater for 75 KW. each.
Two water-tube boilers and superheater for 180 KW. each.
One Green's economiser and two Weir pumps.

St. Sampson's Gas-driven Station.

One battery 50 KW. Capacity 10 hours.
Two 180-KW. "Campbell" gas engine sets.
Two Daniels gas producers.
One 20-ft. diameter gas holder.
Two circulating water pumps and water storage tank.

I am very much indebted to the kindness of Mr. Arthur G. Bird, A.M.I.E.E., the engineer to the Guernsey Electricity Co., and to Messrs. Edmundson's Electricity Corporation, Ltd., for the figures which I am able to give you below, and which I think you will find to be a fair and just comparison of the respective costs of both stations, and of the economy of gas-driven over steam-driven stations.

Originally the St. Peterport steam station was designed for lighting only; since then the demand for power sprang up at the local quarries some two or three miles away, and to transmit the current there, transforming had to be introduced. The steam station for a period took both the lighting and power loads. Since then the St. Sampson gas-driven station has been erected to deal with the power load only, the current for which is delivered direct to the mains.

It is because of the loss incurred in transforming that it was considered by Mr. Bird that the fairest way was to give the costs per

unit generated at both stations. You will see that in September there was an economy of the gas-driven over the steam-driven plant of ·346d., and in October of ·513d. per unit generated on the total works cost.

Messrs. T. H. & J. Daniels, of Stroud, Gloucester. The steam boiler used in connection with it consumed 15 per cent. of the total coal required for the plant. This is not due to any defect in the gas plant, as it compares favourably with any which I know of, but here, it seems

Generating Costs, Guernsey Steam and Gas-Driven Stations, in pence per unit generated.

	STEAM-DRIVEN.						GAS-DRIVEN.					
—	May.	June.	July.	August.	Sept.	October.	May.	June.	July.	August.	Sept.	October.
	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.
Coal, per unit	·502	·503	·452	·458	·525	·583	·255	·240	·240	·224	·248	·248
Stores and water	·042	·044	·042	·042	·078	·078	·072	·104	·104	·056	·048	·048
Wages	·184	·182	·177	·160	·156	·142	·206	·152	·184	·192	·160	·152
Repairs, all plant, mains, and buildings	·122	·146	·092	·076	·163	256	·175	·120	·136	·136	·120	·104
Total works cost ...	·850	·875	·763	·736	·922	1·065	·708	·616	·664	·608	·576	·552
Efficiency of distribution, per cent.	70·6	73	61	69·5	71	71	80	80	80	80	80	80
Units sold	37,776	32,354	32,130	41,906	39,078	38,911	18,565	26,132	29,153	31,130	35,597	40,289
Units generated	53,506	44,241	52,574	60,306	55,133	55,108	23,206	32,665	36,441	38,913	44,496	50,361
Possible units, full load ...	80,700	67,570	68,640	77,460	78,585	85,335	37,620	42,840	47,700	52,200	55,080	61,380
Plant load factor, per cent.	66·3	65·6	76·6	78	70	45·6	62	76	76·5	74·5	81	65·8
Coal per unit generated, lb.	5·9	5·8	5·23	4·83	5·56	6·13	2·6	2·44	2·33	2·19	2·32	2·44
Price of coal in bunkers...	15/10	16/-	16/-	17/10	17/6	17/6	18/6	18/6	18/6	18/6	19/6	18/6
Difference in favour of gas plant, per unit generated	...	...	...	...	...	...	·142d.	·259d.	·099d.	·128d.	·346d.	·513d.

No condenser.
No power load.

With reference to the capital cost of the two plants at Guernsey, I am able, by the kind permission of Messrs. Edmundson's Electricity Corporation, Ltd., to give you the following figures:—

Actual Cost of Plant.

ST. PETERPORT.	ST. SAMPSON.
One 180-kw. triple engine, 160 lbs. working pressure, 420 r.p.m., 270 b.h.p.	One 300-b h.p. gas engine.
One 180-kw. dynamo.	One air compressor.
One boiler and superheater for above.	One 180-kw. dynamo, 250 r.p.m.
One surface condenser, 1,000 sq. ft. surface with steam-driving air pumps and motor-driven circulating pump, suitable for two 180-kw. engine sets, say, half cost.	Half cost gas producer plant and holder.
One feed pump.	One circulating water pump.
Pipes, valves, &c., for such a plant, say, half cost.	Half cost pipework.
Boiler, brickwork, setting and suitable length of flue.	
Chimney of wrought-iron, with suitable foundations.	
Total cost of steam plant, £3,642.	Total cost of gas plant, £3,200

No allowance is made for foundations, buildings, rough labour for erection, or cartage in either case, nor is there included the cooling tower, or any water storage, in connection with condenser plant. This is balanced by water storage tank for the gas plant.

The gas engines at St. Sampson's station consist of two four-cylinder vertical engines of enclosed type, working on the "Otto" cycle, each developing 300 b h.p. on producer gas at 250 r p m.

The engine cylinders are 17 in. diameter × 17 in. stroke, the pistons being direct coupled to a four-throw crankshaft running in three bearings in the bedplate. The sequence of the explosions in the cylinders is No. 1, No. 2, No. 4 and No. 3.

Splash lubrication is adopted for oiling the crankshaft, connecting rods, pistons and cylinders, and this has been found to be very effective and satisfactory.

The whole of the valve gearing is mounted on the top of the cylinders, the cam-shaft being driven by screw gearing and bevel wheels from the crankshaft.

The exhaust valves and exhaust valve box are of special construction, in that they are both independently water cooled. The air valves and valve boxes are of the ordinary type.

The method of governing adopted is that known as the throttle system, which is carried out exactly on the lines of the steam throttle. The gas and air arrive at the throttle valve by separate pipes, and are mixed as they pass through the throttle valve.

The type of valve for the throttle depends upon the nature of the gas employed, but for producer gas an ordinary double beat valve is used.

The gas engine of the type described is at least as well governed as any of the high-class steam engines now made.

By the adoption of four cylinders for the gas engines, an equal and very favourable turning moment is secured, while the balancing of the engine is as perfect as one can get in a moving mass, but in both of these points better results are secured than in a three-cylinder engine. The reasons for this will be obvious to engineers.

The gas plant used in connection with the engines was made by

to me, is one weak spot in all the gas plants hitherto used in this country.

My own opinion is that, in the near future, suction gas plants of larger power will be adopted, as this type of plant does not require a steam boiler or gas holder. Some large plants of this character are already at work, the most recent examples being the central station for lighting and tramways at Scheveningen, Holland, where six gas engines of 500 b.h.p. each and a suction gas plant of 3,000 h.p. are at work. The actual figures as to the cost of working are not yet available, owing to the station having been at work but for a few months, but I can say from knowledge gained by a visit to the station that everything is satisfactory, and the results will be economical.

The difficulty in introducing new things is to get someone to make the first attempt, and in this country I find from experience it is much more difficult to do this than to secure a similar opportunity abroad.

Summary of Results on Six Hours' Trial Run, St. Sampson's Guernsey, September 20th, 1904.

Engine No. 2. Made by Messrs. The Campbell Gas Engine Co., Halifax.

Units generated (watt-hour-meter)	1,120
Average units per hour by watt-hour-meter	186·6 kw.
Maximum load	197 kw.
Average brake horse-power	280
Dynamo efficiency...	90 per cent.

Fuel (Producer and Boiler) Anthracite Peas.

Total coal used in producer	1,664·75 lbs.
" " boiler	242·75 "
Coal used in producer per kw-hour	1·48 "
Coal used in producer and boiler per kw.-hour ...	1·67 "
Gas used per kw.-hour	123 cb. ft.
Calorific value of 1 cb. ft. of gas in B.Th.U. (average of two tests)	151 gross, 143 net
Approximate quantity of gas produced by 1 lb. of coal used in producer	83 cb. ft.
Average pressure on boiler	80 lbs. per sq. in.
Temperature of feed water	say 64° F.
Water evaporated per lb. of coal (at 80 lbs. pressure)...	6·05 lbs.
Equivalent evaporation from and at 212° F.	...7·2 lbs.
Steam used per kw.-hour...	...1·3 lbs.
Maximum amount of CO_2 observed	5·8 per cent.
Minimum " CO_2 "	4·8 per cent.
Depth of fire in producer	... 22 in.
Average blowing pressure (column of water)	... 8½ in.
Gas pressure near engine (when engine was running with load)	¾ in.
Average revolutions of engine	248 per minute
Momentary variation in speed, maximum load thrown off by pulling out main switch	9 per cent.
Permanent difference in speed between maximum load and no load	4 per cent.
Governing	Considered satisfactory.

I may add that in the governing of the engine between its rated load, viz., 180 kw. and no load, the permanent difference in speed is 2½ per cent., and that there is practically no cyclical variation on a steady load.

Another installation, for which my firm has been responsible, is that of Hebden Bridge. The electric lighting scheme for the district was carried out to the specifications of your esteemed President, Mr. Walter Emmott, M.I.E.E., M.I.M.E. The engines consist of a four-cylinder vertical gas engine of similar size to

those made for Guernsey, but as the Hebden Bridge engine uses lighting gas of 600 B.Th.U. value, the maximum brake horse-power developed will be 350 B.H.P. Another engine of the horizontal ordinary type is also installed, but it is proposed to remove this and replace it by a four-cylinder vertical engine of larger power.

The station costs of this installation are not yet available, owing to the short time the plant has been at work; but the results of a test run made by Mr. Emmott and his assistants will be of interest.

RESULTS OF FOUR HOURS' TEST (HEBDEN BRIDGE STATION) ON 300-B.H.P. FOUR-CYLINDER VERTICAL GAS ENGINE.

Makers.—The Campbell Gas Engine Co., Ltd, Halifax.

Capacity of dynamo	140 KW.
Maximum KW. generated...	146·4
Gas consumed per KW.-hour at 146·4-KW. load ...	21·96 cb. ft.
Gas consumed per KW.-hour at 75-KW. load	26·7 cb. ft.
Heat value of gas	600 B.Th.U.
Cost of gas	1s. 9d. per 1,000 cb ft.
Fuel cost per unit generated	·462d.
Efficiency of dynamo	93 per cent.
Mechanical efficiency of combined engine and dynamo...	77 per cent.
Thermal efficiency of engine	33·7 per cent.
Brake horse-power developed with load of 146·4 KW. ...	210

I would remind you that this engine was working considerably under its rated power when the above results were taken. Better results and efficiencies could have been secured if it had been possible to put more load on the engine.

DISCUSSION.

Mr. MCLAREN: Underneath the table of costs for the steam-driven plant at Guernsey, it says: "No condenser and no power load." Does that apply to the October month only, which seems to be higher, or does it apply all through? (Mr. Campbell: "To the October month only.") I have had some experience in putting engines into central stations, and I find that the more economical the engines are, the worse are the results, and this will also apply to the gas engines. In my paper read before the Institution of Mechanical Engineers, July, 1903, I mentioned that none of the gas engine stations showed an economy equal to the steam engine stations. If you compare one station such as Walthamstow with any other station, you may make the figures anything. The author has taken my figures for London at 1d. per unit condensing. Now just to show what can be done by taking individual cases, I looked into the *Electrical Times* costs, and found in London alone five steam engine stations lower in works cost than Walthamstow, and two of these stations are lower in fuel cost, so that you cannot make comparisons unless you take everything into account. It is hardly right to mention engines using a cheaper fuel, and compare them with engines using a dearer fuel. Take the "Diesel" engine, its only source of economy is that it can use crude oil. The gas engine results at Guernsey are excellent, but the steam engine results seem to be very bad, the fuel cost being on an average ·7d. I think there must be some error in the load-factor of 70 or 80 per cent., which is enormously high. Comparing Walthamstow and Guernsey, I find that there is 38 per cent. difference in the price of coal, and there is only 34 per cent. in the cost per unit, showing that Walthamstow is really more economical than Guernsey. The fuel cost at Guernsey is ·5d. for the steam engines, and ·342d. for the gas engines per unit generated. That is a very great difference, being over 50 per cent. in favour of the gas engines, on which the author is to be congratulated; but the steam engines seem to be going very badly. However, it very much depends upon the man who is looking after the machines. When it comes to works cost (it must be remembered that the fuel cost is over 50 per cent. in favour of the gas engine), you find it is only 28 per cent. in favour of the gas engines, and there is more attention required for gas engines. The trend of my remarks is, compare the best gas engine with the best steam engine, and then I will be satisfied, but that has not evidently been done at Guernsey. Coming to the vertical cylinder gas engine, I think the author is here on the right track. The coal used by the boiler for making the gas was 15 per cent. of the total required for the plant; they are therefore using the most economical plant with the worst boiler imaginable.

Mr. A. B. MOUNTAIN: If we could drive engines with gas from our own gas works, to tide us over the peak during the period from October to March, we should benefit ourselves and also the gas undertakings. I do not think that the actual consumption of gas is of very great importance. I believe that the author will agree that an engine governed as his are is not as economical as the old "hit-and-miss" engine, although I think that with an engine of his make it would be quite easy to drive an alternator.

Mr. WOODHOUSE: Are the cranks actually at right angles, or approximately so? It is impossible to balance an engine with four cranks set like this.

The AUTHOR: No, they are directly opposite.

Mr. J. W. DAWSON: I should like to ask the author whether there is any increase in efficiency by introducing water into the exhaust? With regard to using gas engines in addition to steam engines, and taking gas from a gas company, the gas engine would then be taking gas for the peak at the same time as the bulk of gas would be required for lighting. It seems to me there has been a tendency, due to not being able to obtain large gas engines, for the smaller towns to be the ones to take up gas engines, whereas it is well known that a small town does not offer the best prospects. If you were to put down a modern gas engine station in the midst of a big town, what would be its chance against a steam plant? To get a fair comparison, you must take fair comparative areas, and the same system of distribution.

Mr. S. D. SCHOFIELD: I have had the pleasure of seeing the engine which is running at Hebden Bridge. The sound of the engine when working and its external appearance are very similar to the standard high-speed central station type of steam engine. There does not seem to be much more attention required than would be given to a steam engine of a similar size. What is the capacity of this plant to deal with overloads such as are common in stations that are supplying current for tramway purposes? Overload capacity is very comforting to an engineer when the peak load is coming on, in the winter time, and also when he has the holiday traffic to deal with on a tramway system. While fuel costs would appear to show in favour of the gas plants, the wages for the two sets, as given in the paper, do not seem to show any decided advantage in favour of either gas or steam. I should incline to think that the cost of repairs and renewals will be heavier with gas than with steam.

Mr. P. ROSLING: With regard to the power factor, the two months chosen as being so much more economical with gas than steam, viz., September and October, are the particular months in which the load factors are 11 per cent. and 20 per cent. respectively less than for the gas engine. If you, however, take the two months of July and August, where the load factors are approximately the same, the result is only very slightly in favour of the gas engine. I saw two big gas engines recently, of 250 H.P., running on gas from coke ovens, but in less than 12 months they had to take the whole thing to pieces to remove the tar; and I suppose the gas from coke ovens is somewhat similar to that from a producer plant. I should be glad to know whether the author had any trouble on that account. The author shows these engines with fly-wheels at both ends of the crankshaft, has he had any trouble with engines built that way?

Mr. ROGERSON: With regard to the Hebden Bridge results, the fuel cost is ·462d. and it seems to me that it will have to be considerably lowered before the results can compete with steam engines. The momentary variation in speed, the maximum load being thrown off, is given at 9 per cent., and this, again, is extremely high.

Mr. SEATON: I should like to give the costs obtained in a 500-KW. station which Messrs. Willans & Robinson erected in Scotland about three years ago, because I consider they form a very good standard of excellence for steam engines. The coal cost comes out at ·148d.; oil and waste, ·013d.; wages, ·022d.; repairs, ·022d.; total works cost, ·205d.; 5 per cent. interest on £10,000 comes out at ·044d.; and 10 per cent. depreciation on £10,000, comes out at ·088d.; the total cost is, including interest and depreciation, ·337d. These figures are being very well maintained, the figures that were sent to me this year coming out at ·334d. It is a factory plant, and the boilers are working at 250 lbs. pressure, engines running condensing. As far as I know, these figures create a record in electrical generation.

Mr. H. DICKINSON: I think we must all agree that the results obtained with gas engines so far are not very good. In addition to Belfast, where the engines have been taken out, there are Leyton and King's Lynn. At Redditch I understand that there has been very considerable trouble, and I believe that the engines there were out of use for many months, and a steam plant running. All these results make us central station engineers dubious. I wish the author could give us some figures in connection with larger engines. We want economy in total running cost, or economy in first cost; if the running cost is equal and the capital cost is lower, that will do. Another thing we must have—a high-speed engine for very large units, to enable us to get cheaper first cost. If we have a huge vertical engine of 2,000 or 3,000 H.P., the parts are most difficult to get at. High speed, even turning moment, good governing and reliability are what are wanted. With regard to St. Sampson's engine, the load factor is the relation of the load to the plant, and has nothing to do with the load for the year. It is the output per hour compared with the maximum load.

Mr. W. EMMOTT: I ought to tell the author that I find I have to give him, in my final report, credit for 6 per cent. more efficiency than is shown in his paper. As to the comparative cost of a 250-B.H.P. suction plant, and the same power in a water-tube boiler, you can take it that a water-tube boiler will cost 2½ times as much as the suction plant. A water-tube boiler would take twice as much space as the suction plant. Where anthracite can only be obtained at a prohibitive price, coke can be used, and in my own experience it is cheaper to burn coke at 13s. per ton than anthracite at 26s. per ton. The cost of banking up a fire I find in a suction plant of 250 B.H.P. for 12 hours does not come to 1s. Several engines can be run with one producer. An engine can be started up from a banked fire in 15 minutes without difficulty, and you can start up an engine in one minute when the producer is going. I have prepared plans for Hebden Bridge, where I have reason to believe that the Council will adopt the system, and I am of opinion the fuel cost will come down to about ·176, or ·2d.

Mr. CAMPBELL: Referring to Mr. McLaren's remarks about the bad steam engines, I am not making a comparison between this particular make of steam engine, but against steam engines generally, and that is why I have not mentioned the name of the maker. The results of the steam plant are not very good. The gas engine plant has turned a non-paying concern into a paying concern; whether high thermal efficiency has anything to do with it or not, I cannot say. With reference to the boiler for the gas plant, unfortunately, it has been considered by gas plant makers that the fuel consumption in these boilers is a point that need not be troubled about. When you get a big plant, it tells a different tale. I quite agree with the remarks about the boiler. Mr.

Mountain says the consumption of gas is not important; I think myself that it is a very important thing. I presume that he meant that it was not important if the result that he wanted to get was a temporary one, or one that was to help him over the top of the load. The engines at Guernsey, and any other engines that we make, are quite capable of carrying continuously the load at which they are rated. The St. Sampson's engines run at top load, and have to take an overload of 20 per cent. at any time they may be called upon to do so. One feature about the four-cylinder engines is, that they have never been able to pull them up, no matter what load has been on; they have slowed them down, but not pulled them up. The engines at St. Sampson's start at seven in the morning, and run till eight at night without a stop. In September the steam-engine plant ran 480 hours, and the gas-engine plant 412 hours. The sole object of cooling the exhaust gas by water, is to reduce the noise. Mr. Woodhouse refers to an installation in the Isle of Wight which was placed in a very low position in a valley, a very little noise being magnified, and the owners of surrounding property took advantage of it to try to make money out of it. The wages costs at Guernsey seem to be no more than the steam cost, and I do not see any reason why they should increase. With reference to the fuel cost at Hebden Bridge, I would like to point out that the engine was running at half load at the time the figures were taken. As to variation of speed between no load and full load, I do not see that there will be any difficulty in managing to cut down that figure of 9 per cent. to something like 6 per cent., or even 5 per cent. It all depends upon the range of the governor in working the throttle valve. The description which Mr. Seaton has given of the Willans set, and the total cost of ·334d., is remarkable indeed, but it can only be said that it is working under very favourable conditions. Engine slack is suitable for gas-making plants, but I am not an enthusiast about using ordinary coal for gas making. There are a few gas plants made which use a common coal, but the first cost is out of all proportion to the value. I believe that the plant which sticks to anthracite and coke is the plant which is going to live. The steam engines at Guernsey have been working three years, so that they are not very ancient engines. So far we have not had the slightest trouble with our two fly-wheels. I should say that what was wrong with Belfast was the same thing that was wrong with Leyton and King's Lynn, and that was, they had got hold of bad gas engines. But, taking the Belfast experience first, the engines had the old hit-and-miss type of governor, and they could not be got to run in parallel. Then they had difficulties about getting the engines to run at top load. In addition to that, they were using town's lighting gas at 2s. 3d. per 1,000 cb. ft. They were using the old system of ignition tubes. With regard to King's Lynn, I understand they had a great deal of trouble with vibration and noise. With regard to Leyton, I do not know the details. I agree with Mr. Dickinson that high speeds are necessary, but I fear that we shall never be able to get the high speeds of steam engines; our gearing would not be able to stand the 400 or 450 r.p.m. At Guernsey salt water is used for cooling throughout the whole of the engines and the gas plant, and so long as the water is circulated fast enough and is not allowed to increase in temperature too much, there is no salt deposit.

BIRMINGHAM LOCAL SECTION.

THE first meeting of the session was held on November 23rd, the retiring chairman, Mr. J. C. Vaudrey, presiding.

Mr. VAUDREY, in a few introductory remarks, said that members might feel some pride in the success which had attended the work of the past session. The Local Section was now firmly established, and the total membership, including all classes, amounted to 255. They had been particularly fortunate in having secured Sir Oliver Lodge as first President. He congratulated them on retaining as hon. secretary Dr. D. K. Morris, who had rendered them such good service, and had great pleasure in introducing the new chairman. In Dr. Sumpner they had an extremely able man. As principal of the Birmingham Municipal Technical School, he had been responsible since 1895 for its organisation and equipment, and it was due in a great measure to his efforts that the school was now recognised as one of the premier institutions of its kind in the country.

Dr. SUMPNER, who was cordially received, proposed that the hearty thanks of the members of the Section be accorded to Mr. J. K. Catterson-Smith for his work as assistant hon. secretary during the past session, and this motion, having been seconded by Dr. MORRIS, was unanimously carried.

He then delivered his address, the subject chosen being "The Use of Iron in Alternate-Current Instruments," at the same time exhibiting a number of original instruments illustrating the principles put forward, and demonstrating their action by experiments.

Prof. THRELFALL, F.R.S., proposed a vote of thanks to their new chairman for his excellent address; Mr. HENRY LEA seconded the vote of thanks, and the vote was carried with acclamation.

GLASGOW LOCAL SECTION.

IN his address to the Glasgow Local Section, which we briefly noticed in our issue of November 11th, the chairman, Mr. ROBERT ROBERTSON, made some interesting observations on the use of electricity in collieries. After enumerating the various applications of electricity, which he thought would be extended by the perfecting of the single-phase series motor, and describing the systems of winding, &c., in vogue in Germany, Mr. Robertson stated that the average power of 40 or 50 colliery electrical installations in England and Wales was over 400 H.P., some attaining 1,000 H.P. Numerically, the direct-current systems were in the majority, in the ratio of 55 to 45, but in point of aggregate power installed, the alternating current system predominated to the extent of 60 : 40 The progress that had been made in Lanarkshire, the principal coal-mining county of Scotland, was not satisfactory. Particulars had been obtained with regard to more than 80 per cent. of the collieries in that county; of these, only 11 per cent. were using electricity for power purposes, few had installations of more than 200 H.P., and not one A.C. plant was actually at work there. He was acquainted with one installation where the adoption of electricity in place of horse haulage repaid the outlay in between two and three years; in another case an electric pumping plant saved its cost in three years, and other examples of the same kind could be quoted. In Lanarkshire the thicker seams were being exhausted, and the use of electricity would become an important factor in working the lower and thinner seams with profit.

At the Chairman's request, a discussion followed on the subject of the address.

Mr. W. M'WHIRTER proposed a vote of thanks to the Chairman, and remarked on the unwillingness of mining engineers to adopt new methods, even when the latter were proved successful.

Mr. G. STEVENSON did not regard the question of efficiency as of much importance, as the cost of steam raising was practically nil. Electric power had, however, been adopted in many cases on account of its convenience and adaptability to conditions which could not be otherwise dealt with. The short life of pits in this country restricted the amount of capital that could be expended on colliery plant. Simplicity and reliability were the main considerations in colliery work.

Mr. W. A. CHAMEN questioned the superiority of the A.C. motor with brushes and commutator to the three-phase motors now used.

Prof. BAILY remarked that in Germany the question of cost of new schemes was the last consideration—here it was the first; hence the more rapid development of electrical mining machinery in Germany. Electrical plant was especially convenient in opening up new pits, as it could be easily installed where electric power was available, and removed at small cost when done with. For coal-cutting and haulage D.C. motors were at present in no danger of being superseded by single-phase A.C. motors.

FARADAY SOCIETY.

THE ninth ordinary meeting of the Faraday Society was held on November 23rd at the Institution of Electrical Engineers, Mr. W. R. Cooper being in the chair.

The CHAIRMAN moved that the hearty congratulations of the Society be tendered to the President, Sir Joseph Wilson Swan, on the occasion of the recent dignity which had been conferred upon him by the King. The motion was carried unanimously amid applause.

Prof. L. KAHLENBERG, Ph.D., presented a paper on "Recent Investigations bearing on the Theory of Electrolytic Dissociation." The paper and the discussion form the subject of a special article on p. 922 of this issue.

Mr. F. J. BRISLEE, M.Sc., communicated a paper entitled, "The Potential of the Hydrogen-Oxygen Cell," which was read by Dr. F. M. Perkin.

Measurements of the potential of the combination $Pt_{H_2}/\frac{N}{1}$ acid PtO_2, show different results when the oxygen electrode is charged with oxygen electrolytically, or charged by passing oxygen gas through the liquid. Experiments were made to determine the influence of hydrogen peroxide, ozone, and persulphuric acid upon the oxygen potential. The results obtained showed that the addition of hydrogen peroxide lowered the oxygen potential, while addition of ozone and potassium persulphate raised it.

By employing platinum electrodes of extreme thinness (prepared by depositing platinum on glass), the same potential of the combination was obtained independently of the method employed for charging the electrodes. This potential showed a good agreement with that calculated from the Helmholtz formula.

Mr. H. L. JOLY, referring to the effect of persulphates, said that in accumulators it had been proved that their presence did not account for the rise of E.M.F. on charge.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week.

Running Steam and Gas Dynamos in Parallel.

May I ask through the medium of the "Correspondence" columns of your Journal, whether any of your readers have had any experience of the running in parallel of a Westinghouse direct gas-driven set with a Willans steam engine, say, of about 40 KW. size? I am anxious to know if there is any great difficulty in so doing.

Parallel.

Guarding the Live Rail.

I would like information on the following points:—

1. The possibility of effectually protecting the live rail throughout its entire length.

2. Have any accidents occurred due to coming in contact with the rail, at the portions which are at present protected with boards?

3. The approximate cost per mile of effective protection in (1).

Charged.

The Unipolar Dynamo.

I read with much interest the short article on the unipolar dynamo or motor. From it, I gather that little improvement in principle has been made since the time of Faraday, and that the machine is only commercially available for large currents of a low voltage; and, also, that it is still necessary that part of the current-carrying circuit should be movable.

Some years ago I went into the problem—at first, with a view to designing a generator of an absolutely fluctionless current for telephone work; and, later, for a dynamo or motor having no moving current-carrying parts, so as to obviate collection difficulties, and be available for the generation and utilisation of much higher voltages than in present use. Secondarily, an amorphous idea of a combination of the unipolar generator with the rotation field altermotor, with a view to a stationary transformer and rectifier.

The first great difficulty to overcome was obtaining a series winding so as to increase the voltage of a definite current, and the second difficulty was the elimination of the moving part of the circuit. These conditions led to a radical departure in the design of the machine, as may be expected.

The greatest difficulty necessitated by raising the voltage becomes apparent from the general formula,

$$\text{Voltage} = \frac{\text{Linear velocity} \times \text{conductor length} \times \text{B}}{10^8}.$$

Since there is a practical limit to revolution speed, any attempt to increase the linear velocity and conductor length, by increasing the radius of the rotatory part of the machine, results in pulling down the value of B, and the product of all three terms must necessarily be pretty large to stand the denominator 1,000,000,000; to say nothing of machine losses.

The author of the paper in question justly points out that the advent of the steam turbine (commercially) opens the field to this class of machine, and though not in a position to state definitely, it appears as if the wear and tear on a unipolar machine would also be less (as well as first cost) than the present types of generators and motors. This assumption, however, is a matter that can only be proved, one way or the other, by experiment and practice.

Calculations based on the general formula do not give very much room for optimism, but perhaps some of your correspondents might be willing to give the results of their experiences with the class of unipolar machine at present in use.

J. L. D.

In connection with the abstract which appeared in your issue of November 18th of Mr. J. Seidener's article on the unipolar dynamo, there is one point which does not seem quite clear.

Would not the flux in the field system rotate in the same direction as the armature? There would evidently be a torque, equal to the torque exerted by the prime mover minus that lost in friction at the bearings, tending to produce this rotation of the field. The eddy currents generated in the iron of the field system would check the velocity of any such rotation, by opposing it by a torque which would vary directly as the angular velocity of the flux.

In Mr. Seidener's formula for the E.M.F.,

$$E = 3{\cdot}08\ D^2\ n\ 10^{-6},$$

he does not allow for any such movement of the magnetism in the field system. Is this because it does not occur at all, or, as seems more probable, that the eddy currents so limit its velocity that it is inappreciable, even at full load?

If this latter is the case, it is of interest to note that unipolar dynamos, no matter of what design, could not possibly be made with a laminated field system.

W. F. Wolfe.

Preston, *November 23rd*, 1904.

[The flux does not rotate; and, if it did, there would not necessarily be any eddy currents.—Eds. E.R.]

The Cult of the Marine Engineer.

With regard to "Landsman's" opening remark, "Why abuse the marine engineer?"—were the "Tirade" writer to answer truthfully, he would say, "Because he has proved a better commercial investment to his employers than ever I can hope to be." Now I have not the slightest desire to raise bitter feelings between any sections of men, but surely he was ill advised when he wrote in the strain he did. The marine man is evidently just as able to express his resentment at such attacks as he is to hold his own in open competition with men of the "Tirade" writer's stamp. As regards his criticism on the ability required at sea, no answer is necessary, for his ignorance of the subject is too apparent to be taken seriously. A few voyages—if he was long enough retained by any superintendent to make them—would considerably alter his opinion.

There are no repair shops at sea, and it's absolute nonsense talking about the company's works staff. Is he aware that 90 per cent. of ship-owners have no works staff, and the ship's engineers have to do their own repairs, so far as the manual labour part of it is concerned? Were he a marine man, he might obtain the awful ticket, but I'm afraid, if he worked on the same system as he writes, the sack would be more in his routine, and, instead of blossoming as a ladies' man, he might, if he studied hard, get a berth as a greaser. Since the letter from him appeared, I've made a few inquiries in stations in and around London, and the result is certainly disastrous for the Finsbury and other Institute double-distilled article.

I use numbers to distinguish the stations, the editor having the proper names, which it would be unjust to publish.

In No. 1 station four men (marine), salaries 75s. to 60s. per week.

No. 2 has three men (non-marine), salaries 28s. to 20s. This is a much larger station than No. 1.

No. 3 has three men (marine), salaries 80s., 60s. and 50s.

No. 4 has two men (marine), salaries 60s.

No. 5 has three men (non-marine), salaries 40s. to 30s.

No. 6 has three men (marine), salaries 60s.

No. 7 has three men (non-marine), salaries 50s. to 38s.

No. 8 has three men (marine), salaries 60s.

At a vacancy in No. 8 lately, although not advertised, there were over 20 applicants trained electrically and brimming over with knowledge who *offered their services from* 30s. *to* 40s. *per week*. Now these are the real culprits in keeping salaries down, not our marine friends, for the lowest salary asked by a certificated man was 50s. In this case a 60s. man got the berth, although he had only been in a station previously as a fitter. I'm not underrating the value of technical training, very far from it, for I appreciate it, and endeavour always to encourage it, but 10 years' experience of merely electrically trained men causes me to be rather doubtful of them. The coming man for central station work is the present youth, and he must be a hybrid sort of creature. Certainly, with the advantages our present-day youth has, there need be no limits to him rising to the very top of his profession, for what with institutes for day and evening work, free libraries with access to the very latest books on every improvement, lectures and opportunities of visiting works and stations, seeing plant produced practically from the mineral stage to the finished article, and finding everyone, not only willing, but anxious to explain any detail, gives him a chance his father never had. For most of the men now at the top had to beg, borrow, and slave their way through difficulties that it is impossible to realise now in order to obtain the requisite knowledge they wanted. The average student of to-day doesn't think of this, he undergoes his theoretical course of training, and then migrates to a central station in search of experience, and then what happens; he fritters away his

time with his hands in his pockets, or if he has a few more of his cloth, he spends a good deal of time discussing his late secretary, the manager, or the station superintendent, and wondering why these gentlemen don't seize the chance of obtaining their valued services, as they are quite sure they just possess the requisite talent to save the place from bankruptcy and put it on a good basis. Ultimately, they get a berth at 20s. per week, and are dear at the price; for as regards going into a boiler, they never dream of it, and, well, they wouldn't know what to do or how to do it if they did. Now nearly all the firms I've referred to are owned by hard-headed business men, or at least managed by them, and does it not seem rather queer that they fight shy of the cheap man, rather paradoxical for them to pay higher than they need to with all the talent floating about our Institution lobbies, only waiting for the opening, when Marconi, Edison, and such like amateur electricians and scientists will have to hide their identity and be very humble indeed? Or else they may find that they will be everlastingly quashed by a Tirader.

With apologies for encroaching on your valuable space, and enclosing my card.

Kia Ora.

[We have received a letter signed "Shift Engineer," in which the suitability of the marine engineer's training for electrical work is criticised. But our correspondent has failed to give his name and address, and his letter is therefore excluded.—EDS. E.R.]

Telephone Installation.

I should like to make a statement with reference to "Information Wanted" *re* telephone installation on p. 859 of your last issue.

Your correspondent states that he has tested the twin cable for contact faults, and finds the insulation correct, but yet he can distinctly speak from one circuit to the other, although there is no apparent metallic contact between. I think that if your correspondent will test his earth connections, he will find one of them at fault, and this is the cause of the apparent contact.

The telephone line No. 1 should run to earth through bell or receiver; but if the earth is defective, it forms a very high resistance to the current, and the current finds an easier passage through the telephone bell coils or receiver connected to circuit No. 2, as probably the telephones both work off one earth wire, and thus completes its circuit through line No. 2 into earth, which is of low resistance at the other end, the result being, viz. :—You speak over No. 2 line through the earth wire; instead of the current flowing to earth, and the resistance being lower through bell coils or receiver at station connected on No. 2 line, the speaking is made quite clear on both lines. The ringing fault also points to a bad earth.

R. L. Murray, *Engineer.*
THE NEW SYSTEM PRIVATE TELEPHONE CO.

London, E.C.,
November 26th, 1904.

Contractors v. Supply Companies.

We have before us a circular received from the electric lighting company who supply our premises with energy, offering to examine our lamps and fittings, and advise us as to the best lamps to use, and also to test our installation, for a nominal fee. We should like to acknowledge receipt of this through your columns, and at the same time to decline their kind offer "mit tanks," as, during the past 22 years, we have qualified to make these very essential examinations and tests without calling for assistance from the other side of the meter.

From a contractor's point of view, the step this particular supply company propose to take is, to say the least, grasping, and is calculated to introduce between intending consumers and the company in question, a "resistance" of an unknown quantity, as shown by the following :—

Now that there is competition between the City lighting companies, the contractors are invariably consulted by consumers as to which service should be introduced, and it is not only within the bounds of possibility, but most probable, that the requisition forms of the enterprising company, which has intimated its readiness to undertake work for consumers, will be "shunted." The forms most likely to be used are those of the company which appreciates the assistance rendered by contractors in procuring consumers who make the load line less precipitous, by leaving the consumer's side of the meter severely alone.

In conclusion, would it be inappropriate to ask if the alteration of light outside the Mansion House and Royal Exchange, from electric arc to high-pressure incandescent gas, is the result of advice from the supply company who are so desirous to obtain the highest efficiency in this city?

What have the L.E.C.A. to say on this matter?

W. K. Partington & Co.

London, E.C.,
November 28th, 1904.

Automatic Battery Regulating Switches.

Replying to your correspondent's question in last week's REVIEW as to the makers of automatic regulating switches, Dr. Paul Meyer, of Berlin, manufactures a very reliable switch of this kind.

If required to vary the voltage from the house, it is only necessary to run a pair of No. 16 wires to a small rheostat on the house switchboard, which is connected in circuit with the contact voltmeter of the regulating switch. Also, the voltage can be set up to the number of regulating cells by adjusting weights on the solenoid core of the contact voltmeter.

This switch is entirely automatic on a discharge, and the engine room may be kept locked till again charging.

C. N. Ephgrave.

Airdrie, N.B., *November 28th*, 1904.

[Messrs. Drake & Gorham also inform us that they make a switch of this description.—EDS. E.R.]

Corrugations in Rails.

On the Hull Tramway rails a peculiar corrugation has appeared along the whole length of rail; the length of each corrugation (from crown to crown) is about 1 in., and it shows very plainly when the light strikes it aright. The above cutting is from the *Hull News*. The rails are from Belgium, and are centre-grooved. Can you or your readers explain this?

X.

[This phenomenon has attracted much attention lately; the explanation seems to be obscure.—EDS. E.R.]

Economy—Gas Engine v. Motor.

I wonder if any of your numerous readers could oblige me with any useful figures showing the cost of maintaining and running electric motors, compared with gas engines, particularly the smaller sizes. There must be many who have had occasion to schedule results upon this subject.

Substitute.

[See ELECTRICAL REVIEW for February 26th and April 15th, 1904, and other recent numbers.—EDS. E.R.]

LEGAL.

FISHER *v.* UNDERGROUND ELECTRIC RAILWAYS CO. OF LONDON, LTD.

AT the Brompton County Court, on Monday, before Mr. Clement Lloyd and a jury, Albert Fisher, a fitter's labourer, brought an action under the Employers' Liability Act against the defendants. The plaintiff claimed damages in respect of personal injuries, said to have been sustained owing to negligence on the part of the defendants or their servants.

Plaintiff's Counsel said that on May 31st last his client was in the employ of the defendants at Lot's Road, assisting in raising a very heavy iron pipe from the ground on to a large staging. The pipe fell with a crash on the staging, which at once collapsed. The men, including the plaintiff, fell some 30 or 40 ft. to the ground. The plaintiff sustained serious injuries. Counsel contended that the staging was deficient for the work, and particularly that the rope or sling was defective. The only defence filed by the other side was that the plaintiff had "exercised his option" by

receiving half wages under the Workmen's Compensation Act, and so was debarred from claiming a lump sum under the Employers' Liability Act.

Evidence was given on this last point, that plaintiff signed certain papers, when at the hospital, in ignorance of their contents.

For the defence, Albert Lloyd, a clerk in the employ of the Employers' Liability Insurance Co., stated that the plaintiff's father, after being referred to them by the defendants, distinctly stated that the plaintiff was willing to receive compensation under the Workmen's Compensation Act.

Ernest Baylis, an inspector in the employ of the Insurance Company, stated that, when he paid the first week's compensation in the hospital, he read over the document to the plaintiff and his father before they signed it.

Further evidence having been given, the jury returned a verdict in favour of the plaintiff, assessing the damages at £81 16s.

His Honour gave judgement accordingly, and allowed costs.

Boor *v.* Salford Corporation.

At the Manchester Assizes on November 23rd and 24th, this case was heard before Mr. Justice Walton. Briefly, the plaintiff claimed damages for serious personal injury arising from an electric shock sustained while travelling on one of the defendants' cars on February 2nd last. The plaintiff's case was that on boarding the platform of a car on the date mentioned, and grasping a canopy pole to steady himself at the moment the car started, he received a severe electrical shock, which, in medical opinion, had the effect of rupturing the ligament in his knee. Plaintiff was under treatment, and laid up for some months, his out-of-pocket expenditure, with loss of business, being set down at £965. Both expert medical and electrical evidence was called in support of his case, the latter suggesting that leakages of current were not uncommon in cars of this type.

For the defence, it was pointed out that unless negligence on the the part of defendants were proved, they were not liable. The car in question was electrically equipped by the British Westinghouse Co. in 1902, and since the accident had been tested carefully without revealing any leakage. Further, the injury might have resulted from sudden contraction of the muscles, due to shocks not electrical.

Mr. C. R. Bellamy, Mr. G. F. Metzger, Mr. Charles Hopkinson, Mr. James Swinburne and Dr. E. Marchant gave expert electrical evidence for the defence, claiming that the insulation was in good order, and that it was impossible for plaintiff to obtain a shock when on the platform, whether the car were electrified or not, as the same electrical pressure would exist on the various parts of the car.

The Judge, in summing up, remarked that the defendants' liability depended upon whether there had been any negligence or not. The defendants denied electrical shock, and said that plaintiff stumbled, and his injuries were consistent with either theory.

The jury returned a verdict for defendants, and judgement was given accordingly.

Mr. Wharton, for plaintiff, asked for stay of execution on the ground of the rejection of evidence as to habitual shocks on the defendants' cars, which should be coupled with the question of defendants' negligence.

His Lordship agreed to counsel bringing up the matter later on at Liverpool.

In *re* the Nernst Electric Light Co.

In the Chancery Division of the High Court of Justice on Tuesday, Mr. Justice Swinfen Eady had before him a petition by the Nernst Electric Light Co. for the reduction of its capital.

Mr. Eve, K.C., who appeared with Mr. Colefax for the company, said the reduction was a very large one, but the price originally obtained by the company for it patents rights seemed to be out of all proportion to their intrinsic value. The company was desirous of putting its house in order by getting rid of the large incubus of capital, which was really not represented by available assets. Originally there were preference shares as well as ordinary shares The reduction involved a modification of the rights of the preference shareholders; in fact, to some extent an extinction upon terms that were acceded to by a very large majority of the shareholders. There was no notice of any opposition, and there was not at any of the meetings any expression of dissent. When it was formed the company hoped that it had acquired an article of commercial use in the land, and proceeded to establish a laboratory and to convert it into a factory. It expended on the warehouse and these technical matters a sum of £17,355, and the only assets it had to show were machinery and plant to the value of £250. The British royalties were of considerable value. The English company was now unable to manufacture the lamp at all. What it had to do was to go to a German company who had some secret process by which the lamps appeared to be made marketable. It was now a mere selling company of lamps, which would be manufactured by this German company. The British royalties were most valuable. The process of producing the lamps was a very difficult one, and in large parts of the company's districts electricity was unknown, and in some other parts the lamp had shown itself to be unsuitable on account of its unreliable behaviour, especially with varying voltages, and unless the lamps could be further improved, he questioned whether the earning power of the company would exceed something between £4,000 and £5,000 a year. Many of the shareholders in the company were men of large commercial and business experience, and during the last year considerable discussion had taken place within the body of shareholders as to the question of the revaluing the company's assets. This question had been gone into most carefully, and it had been agreed that, in round figures, £90,000 was the correct figure at which to value the total share capital of the company, and he was clearly of opinion that all the capital beyond this figure had been either lost or was no longer represented by available assets. In round figures, the investments, office furniture and fittings, excess of book debts due over book debts owing, and other sundry assets, amounted to something like £24,000. The patents, if valued in the light of real earnings, and taking into consideration the fact that they would expire in 1913, could not be treated as worth more than £46,000, and the royalties on lamps sold in England to which, under the agreement, the company was entitled, might be estimated as worth another £20,000, making a total of £90,000. Mr. George Cloutte, an accountant, stated, in his affidavit, that, after a careful consideration of the company's position, as shown by the balance-sheet at September 30th, 1903, he was of opinion that the paid-up capital of the company was at present unrepresented by available assets by at least £230,000. The expenditure for experimental purposes must be regarded as lost, and the value of the rights originally paid for must be considerably reduced by reason of the inability of the company to manufacture lamps for sale. The amount of £212,197 15s., which, according to his statement, should be written off the value of the patent rights would leave the remaining value at £66,136 2s. 1d., and if the British royalties be taken as worth £20,000, which sum having regard to the income they had produced to the company, and to the terms of the patents, was, in his opinion, a fair estimate of their value, the patent rights originally acquired would then stand at a sum of £46,136 2s. 1d. In his judgement, having regard to the profit realised, and to the length of the patents, this was a sufficiently, if not too high, valuation. Proceeding, the learned counsel said this case was really founded in great measure on the Welsbach case. There were patents which it was impossible for any one to really value with anything like accuracy, and the basis on which the evidence proceeded, was what was the earning capacity of the company? Between £4,000 and £5,000 was not a very large return for the capital. If they were too sanguine, it was their misfortune, but it could not be said they had written off too much.

His Lordship granted the petition for the reduction of capital as sought.

Johnson *v.* West Ham Corporation.

A boy named Johnson, aged 3½ years, brought an action in Bow County Court recently, through his father, to recover damages from the West Ham Corporation for personal injuries alleged to have been caused by an electric flame coming out of a feeder box. It appeared that on June 29th, the child, with his elder brother and sister, was playing round a feeder box near Beckton Road, when suddenly electric sparks came from a hole in the box, and burnt and blackened the child's hand. The father wrote to the tramway manager about the matter, and in reply he received a letter from Mr. Bullock (the electrical engineer), in which he said that a piece of wire must have been put into the box, and "the result of this wanton interference with the Corporation's property might easily have resulted in a serious accident, and if any serious damage had resulted, I should certainly have taken proceedings against you." The child had his hand on the box at the time when the fire came out and burnt him. A brother of seven was further questioned as to whether the boy had put a piece of wire in the hole, but he denied that this had been done.

Mr. Witticombe, the superintendent of the overhead equipment, said one of the switches in the box was burnt off, from which he concluded that a metallic contact had been made between the inside of the box and the switch. He came to the conclusion that the children had pushed a piece of wire through the hole. It was quite impossible for the flames to come out in the way described by the children.

The Borough Electrical Engineer said he came to the conclusion from the report of the last witness that a piece of wire had been pushed in. It would be impossible for a child to be burnt unless a piece of metal was put in the box.

His Honour, in giving judgement, said that he thought it was impossible for a small boy like that to put a piece of wire in at that height, and there was no trace of evidence that this had been done. There was a hole in the box, and even though the Council had statutory powers for the supply of electricity, they should do their work in the safest possible manner, and it had been shown that they could do it without the hole. It must have been a shock to a small boy like this; and as the claim was not unreasonable—£10—he should give judgement for that amount with costs.

Longman *v.* Bath Electric Tramways, Ltd.

In the Chancery Division on the 23rd ult., Mr. Justice Farwell heard this action, which was brought by Thomas William Longman and William Longman, claiming registration of a transfer of 500 shares in the company to the plaintiff, William Longman, and of 1,000 shares in the company to the second plaintiff, Thomas William Longman, or alternatively damages to the amount of the value of the shares.

The action was dismissed with costs.

Sir Hiram Maxim Electrical and Engineering Co.

Mr. Justice Warrington on Tuesday had before him a creditor's petition for the winding up of this company.

Mr. Hy. Terrell, K.C., for the petitioner, said the company was incorporated in 1899, and its present capital was £190,000. It had entered into a contract to erect at Southport certain parts of a captive flying machine, and the petitioner did part of the work at a contract price of £1,576. He received a cheque for £100, and five bills amounting to £964, leaving a balance of £511. The first bill, for £200, was dishonoured on presentation. The company had issued £20,000 debentures and appointed Mr. Hardy, the managing director, receiver on behalf of the debenture holders, and it had since gone into voluntary liquidation, Mr. Hardy being appointed liquidator. On behalf of the petitioner an affidavit was put in, stating that the object of the voluntary winding up was to delay and embarrass unsecured creditors. The affidavit further stated that shares in the Sir Hiram Maxim Lamp Co., Ltd., which were assets of the company, had been paid to certain creditors within three months of the winding-up in satisfaction of debts in order to give them a preference. Mr. Hardy, in another affidavit, replied that if this was done, it was done in the interest of the company, and not of individual directors, that if the company were reconstructed there would be more than enough to pay all its debts in full, and that a reconstruction scheme had been submitted to, and approved by, a large majority of the debenture and shareholders and creditors.

Mr. Eve, K.C., M.P., submitted that there was no case for superseding the voluntary winding-up, which would not prejudice creditors. The only honest and prudent course to pursue was to stay all possible preference or priority which could be gained by persons recovering judgement by going into liquidation. There was no evidence to support the suggestion of fraudulent preference, and the transactions in question might possibly have taken place to avoid forfeitures under contracts which were running.

His Lordship did not hold with the evidence that there had been fraudulent preference; but Mr. Hardy's statements in reply to the petitioner's affidavit were most unsatisfactory. It was a case in which the powers of the Court as to inquiry ought to be exercised, and he thought voluntary liquidation ought to be superseded by a compulsory order.

Calcium Carbide Patent Case.

In the House of Lords on Tuesday, before the Lord Chancellor and Lords Davey and Robertson, the case of the Acetylene Illuminating Co. and the Willson Laboratory Co. *v.* The United Alkali Co. was heard on appeal by the plaintiffs from a judgement entered in an action tried before Mr. Justice Buckley and affirmed by the Court of Appeal. The plaintiffs claimed an injunction to restrain infringement of Letters Patent No. 16,705, of 1894, granted to Thomas Leopold Willson relating to an alleged invention of a new process for the manufacture of crystalline carbide of calcium, a chemical combination used chiefly for producing acetylene gas. Mr. Justice Buckley had held that the defendant company had not infringed, on the ground that, in his judgement, the patentee had restricted himself to an arc furnace, whereas the United Alkali Co. had used an incandescent furnace. In the Court of Appeal, their Lordships decided that the patent was invalid for want of subject matter, and on the ground of anticipation. They held that, under these circumstances, the question of infringement was immaterial, and they did not, therefore, decide it.

Mr. Fletcher Moulton, K.C., and Mr. Colefax appeared for the appellants, and Mr. Cripps, K.C., Lord Robert Cecil, K.C., and Mr. Walter for the defendants.

Their Lordships, without calling upon the respondents, dismissed the appeal, holding with the Court of Appeal, that there was no proper subject matter for the patent.

Edwards and Brown *v.* Anderson & Hammond.

Mr. Justice Kekewich in the Chancery Division on Tuesday, concluded the hearing of this case, an action by the plaintiffs to recover £93 balance of account for services rendered under an agreement, which plaintiffs alleged was made by the defendants.

Mr. McCall, K.C., and Mr. Neale, appeared for the plaintiffs; and Mr. Aliley for the defendant Hammond.

Mr. McCall said the plaintiffs were two experienced mechanics who had discovered an improved method of making conduits for electrical wires. In order to work and exploit the patent, and if possible, form a company to work the invention, the plaintiffs were introduced to the defendant Hammond, who was secretary to several companies, and had offices at Dashwood House, New Broad Street. Mr. Hammond suggested that the plaintiffs, who were unacquainted with the process of forming companies, that they should leave with him particulars of their invention, and that he would find some one who would go into the matter with him, and form a company to work it. Plaintiffs were subsequently introduced to the defendant Anderson by Hammond, and were told that that gentleman would assist in finding the capital and promoting a company. Plaintiffs were induced to leave their employment on the promise of the defendants that they would pay them their wages until the syndicate or company came into existence, and it was on that contract that the plaintiffs' claimed. From time to time the plaintiffs received some money from the defendant Hammond. The learned counsel said that they had had notice that Anderson had become a bankrupt, and therefore he proposed to go on against Hammond only.

Plaintiffs, having given evidence in support of counsel's opening statement, the defendant, Hammond, was called, and said that some years ago when he was secretary of a firm of electrical engineers, he knew the plaintiff, Edwards, who was then a traveller. Edwards put his scheme before him, and witness told him he was too busy to take it up, but he introduced to him, Anderson, who was to form the syndicate. Witness never had anything to do with the business, and never engaged or agreed to pay plaintiffs any salary.

Mr. Frederick C. Anderson was called, and stated that he became bankrupt in September last. Beyond the introduction of plaintiffs to witness, Mr. Hammond took very little part in the matter. Witness denied that he asked the plaintiffs to leave their employment, or that he promised to pay wages.

His Lordship, in giving judgement, held that the plaintiffs had not proved their case sufficiently, although, in his opinion, the plaintiffs were both truthful witnesses. As to the evidence of Hammond, he did not hesitate to say that he did not believe him from beginning to end. If, therefore, the evidence of plaintiffs had been up to the mark, he would have had no hesitation in giving judgement in their favour. The plaintiffs had been foolish, and they had been victims. In his opinion, Hammond was really the promoter of the company, and looked forward to being the secretary; but, although his Lordship was sorry for the two plaintiffs, he could not find that there was sufficient evidence to give judgement for them, and he must, therefore, enter judgement for the defendants.

Bolton *v.* Sheffield Corporation.

At the Sheffield County Court on 24th ult., Joseph Bolton, herbalist, and a stallholder in the Sheaf Market, sued the Corporation for £2 10s. damages sustained by him owing to the defendants allowing an emission of grit from the electric power station chimneys.

Plaintiff's evidence was to the effect that grit (samples of which were produced) had fallen on his goods, damaging them as stated, and the present action was brought mainly to obtain a cessation of the nuisance. Defendants produced evidence to show that special contrivances were in use to prevent the emission of dust from their chimneys; also, that within a radius of 260 yards of plaintiff's stall there were 25 factory chimneys, some of them in connection with annealing furnaces.

His Honour, in giving judgement, said plaintiff's case was entirely disproved, and he therefore found for defendants, but without costs.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending November 24th, 1903.		Week ending November 22nd, 1904.	
Adelaide	Value £65	Alexandria	Value £170
Aden. Teleg. mat.	60	Amsterdam	98
Alexandria	85	,, Teleg. wire ..	271
Amsterdam	100	Auckland	363
Beira. Teleg. mat.	252	Beira	15
Bombay	70	Bombay	263
Buenos Ayres	54	,, Elec. machinery ..	116
,, Teleg. cable ..	1,541	,, Teleg. mat.	21
Calcutta	512	Bremen	57
Cape Town	1,205	,, Teleg. apparatus ..	236
Carlskrona. Teleg. cable ..	128	Buenos Ayres	403
Colombo	175	,, Elec. machinery ..	178
Delagoa Bay	178	Calcutta	154
,, Teleg. mat. ..	5,844	,, Elec. cable	78
Durban	1,589	,, Elec. machinery ..	258
Gibraltar	86	,, Teleg. mat.	7
Halifax. Teleg. mat.	60	Cape Town	21
Hong Kong	348	,, Elec. machinery ..	217
Lisbon. Elec. cable	47	Christchurch	118
,, Teleph. mat.	112	Durban	1,623
Madras	16	,, Elec. machinery ..	1,549
Melbourne	339	,, Teleg. cable	1,246
Ostend	56	East London. Elec. machinery	118
Otago	30	Flushing. Elec. machinery ..	39
Paris	14	Genoa	139
Port Elizabeth	119	Gibraltar	1,190
Rodriguez. Teleg. mat. ..	70	Helsingfors	16
Rosario	57	Malta	83
Shanghai	55	Melbourne	98
Singapore	199	New Caledonia	19
Sydney	884	Otago	120
,, Teleg. mat.	230	,, Elec. machinery ..	10
,, Teleph. cable	840	Paris	17
Wellington	43	,, Teleg. mat.	3,220
,, Electrical cars ..	5,050	Perth	105
Zanzibar	578	Rotterdam	76
		,, Teleg. mat. ..	24
		Saffi	84
		Saigon	17
		St. Petersburg. Teleg. cable ..	1,420
		Shanghai	28
		,, Teleg. mat.	95
		Singapore	270
		,, Teleg. mat.	33
		Sydney	638
		,, Elec. cable	1,297
		,, Elec. machinery ..	161
		,, Teleg. mat.	14
		Trinidad. Elec. machinery ..	269
		Wellington	1,048
		,, Teleg. mat. ..	602
		,, Telephones ..	927
Total ..	£21,091	Total ..	£19,585

Foreign Goods Transhipped.

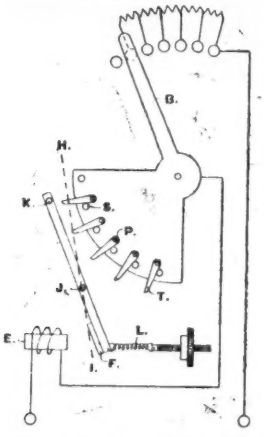
Alexandria. Elec. goods	Value £3
Durban. Elec. goods	17
Otago. Cable telegraph ..	30
Shanghai. Elec. goods ..	145
Sydney. Elec. goods	196
Total	£676

Electrical Trade Prospects in Greece.—"Helios" states that, from official reports, it appears that extensive business is being done in Greece in scientific instruments, preference being given to foreign productions. It is also stated that Great Britain and Germany have secured a considerable trade in Tiflis, and that there is a good market for brass fittings for electric light, such as brackets, electroliers, &c., and a growing demand for electrical goods, especially porcelain insulators.

Australia.—The *Export Zeitschrift für Elektrotechnik* (Helios) states that the Australian Commonwealth has fixed the Customs duties on electro-medical cells and batteries at 12·5 per cent.

For Sale.—Messrs. P. Huddleston & Co. will, on December 7th, sell the stock and plant of an electrical engineer and motor accessories agent at Hammersmith.

Motor Slow-Starting Switch.—Mr. N. D. Phillips, of 5, St. Dunstan's Road, West Kensington, sends us particulars of the switch of which an illustration is given herewith. This switch may be used with either series or shunt-wound motors; for simplicity the diagram shows the armature circuit only. The pawls T are hung on pivots P, each pawl resting against a stop S. In the event of the handle B being moved over the contacts too quickly, the electro-magnet E will pull over the iron plate F, thereby bringing the lever K F (which is pivoted at J) into the position H I; the pin K will then engage with one of the pawls T, and prevent any forward movement of the handle B until the current has somewhat subsided, and allowed the adjustable spring L to pull the lever K F back to its



original position. Thus the handle B is free to move forward again. The handle is always free to move towards the "off" position; even if the lever K F is in the position H I, the pawls T, being pivoted, can swing clear of the pin K. This mechanism is merely to prevent a too rapid movement of the handle in starting a motor, consequently no "holding on," or other auxiliary gear, is shown. We may point out that one pawl, pivoted on the end of the lever at K, and engaging with the pins S, would be equally effective and more simple. The principle is, of course, not new; it is embodied, for example, in the train-controlling switchgear of the Westinghouse Co.

Mexican Copper and Rubber Production.—A German electrical trade journal says:—"A specialist in Mexico has stated that during the last 15 years very considerable progress has been recorded in connection with the copper industry. In the fiscal year 1902-3, there were exported 246,607 tons, valued at 18,354 million dollars, and 49,113 tons copper ore, valued at 1,261 million dollars. In the first two months of the fiscal year 1903-4 12,503 tons of copper were produced, valued at 3,471 million dollars, as against 7,623 tons, valued at 2,418 million dollars during the same period of 1902-3."

According to the same paper the india-rubber production of Ceylon is steadily increasing. In 1903 exports were 48,800 lbs. of first-class rubber, and it is expected that the figures will ultimately increase to 1½ to 2¼ million lbs.

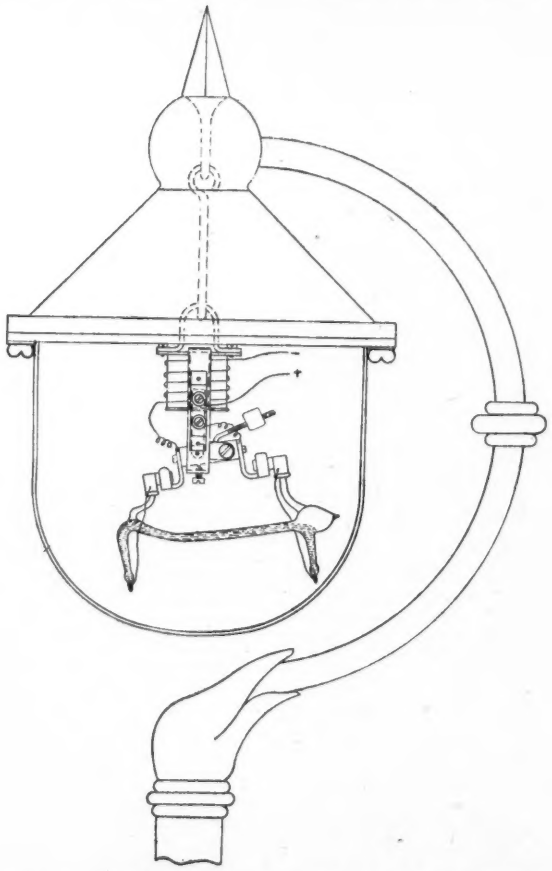
Electric Driving in Cotton Mills.—Messrs. Mather and Platt, Ltd., of Salford Iron Works, Manchester, have recently settled an important contract for the plant required for the electric driving of two cotton mills in Spain, which will be one of the largest and most complete installations of the kind. The well-known spinning and weaving mills with adjoining dye and hosiery works at Malaga, in Andalusia, belong to the Marquess of Larios, who was a pioneer in Spanish manufacturing, and are the largest in the country, employing about 5,000 hands. Arrangements have lately been made by the Marquess for obtaining a supply of electric power from the Chorro Power Co., which has established a generating station in the celebrated Chorro gorge, some 50 miles north of Malaga. The power is transmitted by three-phase current at a pressure of 25,000 volts to a sub-station in Malaga, where the pressure is reduced to 2,500 volts, part of the energy being supplied to the Malaga electric lighting station.

The contract which has been secured by Messrs. Mather and Platt, Ltd., includes the underground cables from the Malaga sub-station to the two mills, "La Aurora" and "La Industria," which are situated at a distance of about half a mile. A secondary receiving station is to be placed at each mill, containing three-phase transformers for reducing the pressure from 2,500 to 400 volts for supplying the three-phase motors, which will be employed universally throughout the mills, the steam plant being entirely discarded. There will be 72 motors, varying in power from 3 H.P. to 150 H.P., and aggregating 2,500 H.P. The Larios Co. anticipate that by the use of electricity in place of steam they will save considerably more than 20 per cent. of the yearly cost of motive power.

There was a very keen competition for the contract by the leading Austrian, German and Swiss firms, and it is highly satisfactory to find that on neutral territory a British firm can secure such a contract in open competition, especially for polyphase plant, to which it has been generally assumed that British makers have devoted less attention than their Continental competitors.

Meldrum Destructors.—Last Monday a L.G.B. inquiry was held at Twickenham concerning the U.D.C.'s application for sanction to borrow the sum of £40,000 for the provision of new sewage and refuse destructor works. The destructor contract has been placed with Meldrum Bros., Ltd., for two two-grate regenerative destructors, two Lancashire boilers, and one Babcock & Wilcox boiler. The Lords Commissioners of the Admiralty also have just accepted Messrs. Meldrum's tender for one four-grate destructor, with Lancashire boiler 30 ft. × 8 ft., for 200 lbs. working pressure, in connection with the extensive electric light and power scheme at Chatham Dockyard, for which Messrs. Preece & Cardew are consulting engineers.

The Bastian Mercury Vapour Lamp.—Messrs. Rumney & Rumney, who are the sole agents for the above lamp, which is now on the market, forward us some interesting particulars in regard to them. From these we note that the present lamp, working at 200 to 250 volts D.C., consumes ·25 to ·3 of an ampere, and that its C.P. is from 120 to 160; the lamp is not at present suitable for alternating current,



but such a lamp is being designed. Special fittings have been made for the above lamp by the Improved Electric Glow Lamp Co., and the firm are making a speciality of street lighting work, for which the accompanying figure shows a typical design.

American Electrical Exports.—The value of the electrical appliances, including telegraph and telephone instruments, exported from the United States during September last is returned at £69,884, as compared with £73,928 in the corresponding month of 1903. On the other hand, the shipments of electrical machinery increased from £64,355 to £98,483. Of the latter total Canada is responsible for £19,870, and England for £19,431, Mexico being third with £12,349.

Exports of British Electrical Machinery.—Satisfactory progress is being made as regards the exportation of British electrical machinery. The shipments during October were the largest so far recorded, viz., £51,268, comparing with £47,777 in September last, and £38,459 in October, 1903. For the 10 months ending with October, the returns show a total of £405,774, which contrasts with £370,281 in the corresponding 10 months of last year.

Bankruptcy Proceedings.—Under the failure of Alfred J. Hollington, electrical engineer, lately carrying on business at 37, Walbrook, E.C., the first meeting of creditors was held on Wednesday at the London Bankruptcy Court. Mr. G. W. Chapman, official receiver, reported that the debtor had stated, in his preliminary examination that, from 1897 to 1900, he traded in partnership with another person at Bush Lane, Cannon Street, E.C., as Fuller & Co., wholesale electrical stores. The partnership agreement was for three years, and provided that, in exchange for the introduction of £1,000 capital, he (debtor) was to be entitled to one-third of the profits. On the expiration of the agreement he retired from the firm, receiving £900, which he invested in F. D. Andrews and Co., Ltd., electrical engineers. That company went into liquidation, and he lost the investment. On December 31st, 1901, he purchased the stock and fittings of a bankrupt firm at 37, Walbrook, for £100, and started business with a borrowed capital of £125. That loan he subsequently repaid with borrowed money. The business was unsuccessful owing to bad debts. The failure was attributed to losses by bad debts and legal expenses. In the absence of any offer, the case was left in the hands of the Official Receiver, to be wound up in the ordinary course of bankruptcy, the public examination being fixed for December 15th. The statement of affairs shows unsecured debts, £301 0s. 5d.; fully secured debts, £440; and assets, "book debts, £191 13s. 11d.," to which no value is attached.

The first meeting and public examination of Albert Smith (lately Electric Motor Supply Co., Nottingham) will take place on November 30th and December 2nd respectively, at Nottingham.

The last day for receiving proofs for intended dividend in the case of Wm. Wenham, electrical engineer, Croydon, is December 5th. Mr. A. Mackintosh, 24, Railway Approach, S.E., is trustee.

December 12th is the last day for receipt of proofs for intended dividend in *re* C. M. Downie, electrical engineer (the Lighting Corporation). Trustee: Mr. C. J. Singleton, 8, Staple Inn, W.C.

Under the failure of Henry Coles, electrical engineer, 10, York Street, Swansea, the first meeting of creditors was held on Tuesday at the London Bankruptcy Court, before Mr. Thos. Thomas, the District Official Receiver. In the absence of any order, the case was left in the hands of the Official Receiver to be wound up in bankruptcy. The chairman reported that a statement of affairs had been filed showing total liabilities £3,727 15s., of which £2,986 was expected to rank against net assets £13, after deducting £35 for the preferential claims. The failure was attributed to losses by bad debts and business expenses in excess of profits, owing to bad trade.

A receiving order was made on November 17th on a creditor's petition against Wm. Watson and Geo. Huntington (Watson and Huntington, electricians, Battersea Rise and Dering Street, Bond Street, London). The first meeting and public examinations are arranged for December 9th and January 24th respectively, at Carey Street.

A receiving order has been made against Harry Cooke, electrical engineer, Longton and Sneinton, on debtor's own petition.

Dissolutions and Liquidations.—Creditors of the McGuire Manufacturing Co., Ltd., are to send particulars of their debts or claims, &c., to the liquidator, Mr. F. W. Pixley, 58, Coleman Street, E.C., by December 31st.

Messrs. W. J. Perry and H. A. Aylett (Perry & Aylett, electrical mechanical engineers, Fulham Road and Chelsea) have dissolved partnership. Mr. Aylett will attend to debts.

Exhibition.—Messrs. Marks & Hodgkinsons, Ltd., of Birmingham, will hold an exhibition of Nernst lamps and Henry's fittings in the Coffee Room at the Grand Hotel, Birmingham, next week.

"Gresolvent."—Messrs. Beanland, Perkin & Co., of School Close Works, Leeds, have forwarded us a sample of their non-acid-antiseptic-grease solvent. This preparation has a large sale in the U.S., and appears to be well adapted for the quick removal of machine grease, ink, &c., from the hands, for which purpose it is being placed on the market.

The Crystal Palace Motor Show, 1905.—In their report issued last week the directors of the Crystal Palace Co. say that the Society of Motor Manufacturers and Traders have withdrawn their support from the Crystal Palace Automobile Show, but the directors have decided to as usual continue the Show, which will be held from January 27th to February 4th, 1905. The directors are taking such steps in connection with the action of the Society of Motor Manufacturers and Traders as they consider necessary and expedient to protect the interests of the company.

Catalogues.—The Sun Electrical Co., Ltd., of Charing Cross Road, W.C., has just brought out its 1905 illustrated catalogue of switches and accessories, including the majority of its latest patterns, and showing reduced prices for standard lines. In switchboards and distributing boards a few illustrations are published for the purpose of conveying an idea of the class of work that the company does in this direction, but the company does a good deal of special work in this department. The other leading features of the list include wires and cables, instruments, incandescent lamps, Simplex conduits and fittings. A large stock of standard lines is kept by the company.

A catalogue of capstan, turret, and hollow mandrel lathes, also tapping, drilling, grinding, milling, and other machines has been received from Messrs. Bradbury & Co., Ltd., Wellington Works, Oldham. The company supplies special lathes for electrician's work, and radial drilling machines for switchboards.

Messrs. Cecil Hodges & Co., of Balfour House, Finsbury Pavement, E.C., have sent us a copy of one of their new price lists of switchboard instruments. It is a well got up and effective list, some good illustrations printed on art paper combining to help in producing that result. Descriptive particulars are given of the firm's ordinary graving and moving-coil instruments, recording instruments, traction switches, porcelain, switch fuses, distribution boards in cast-iron cases, &c. Messrs. Hodges are very busy in switchboard work, having several large central station and traction switchboards in hand.

A very fine list of air compressors has come to hand from Mr. Peter Brotherhood, of Belvedere Road, S.E. The general design and special features are mentioned, and a general description of vertical compressors for moderate air pressure follows, excellent sectional drawings, and half-tone illustrations aiding in the work of explanation. Steam, belt and electrically-driven compressors are shown, also patent clutch and flexible shaft couplings.

A brochure of 54 pp. received from the Allgemeine Elektricitats Gesellschaft, foreign department, of Charing Cross Road, W.C., describes under the title of "Electrical Power Transmission in Mines," several important winding plants which they have carried out on the Continent, also pumping, ventilating, hauling, locomotive installations. The book abounds in illustrations of the equipments referred to.

Messrs. Archibald J. Wright, Ltd., of 318, Upper Street, N., have brought out, just in time for the Christmas present season, a new illustrated price list of electrical goods, and scientific and mechanical novelties; many interesting lines such as electric jewellery, small electric launches and railways, magic lanterns, flash and hand lamps, magnets, model engines, dynamos, motors, coils, and so on, are detailed.

Messrs. F. Hattersley, Pickard & Co., of Leeds, have issued some illustrated circulars relating to their patent screw fans, belt-driven or electric, hot air apparatus and drying installations. The Hattersley-Pickard electric screw fan is very fully described.

The United Telpherage Co., of New York, in an illustrated circular (No. 53) just received, describe an installation carried out by them, in which electricity is applied to the conveying of ashes from the boiler room to cars, hoppers, dumps or barges.

Messrs. Mather & Platt, Ltd., of Manchester, have now issued a second edition of their polyphase generator catalogue in their usual high-class style.

The Lahmeyer Electrical Co., Ltd., of New Oxford Street, W.C., in their No. 29 descriptive circular, give particulars of a new type of small motor for continuous current, single-phase, two and three-phase. The chief feature about these motors is that they are all fitted with ball bearings of an improved type, which are claimed to decrease oil consumption and frictional losses.

Some new leaflets just issued by the Electrical Co., Ltd., particularise their cut-outs for high voltage (List No. 99); casing and capping (No. 100); lamp-holders for Nernst lamps (No. 109).

Sheet No. 9, issued by Messrs. Bray, Markham & Reiss, Ltd., of Walthamstow, give prices and particulars of their shunt rheostats, and No. 10 deals with their circuit breakers.

The Sun Fan Co., Ltd., of Bradford, has just placed in circulation new catalogues of its propeller and centrifugal fans, both for belt-driving and direct-connected electrical driving.

German Electrical Industry.—The Berlin correspondent of the *Times* states in Monday's issue:—"The position of the German electrical industry continues to remain eminently favourable, and work is plentiful. The Siemens & Halske Electrical Engineering Co. is able to announce a dividend of 7 per cent. for this year, as against one of 5 per cent. last year. According to the annual report of the Allgemeine Electricitäts Gesellschaft, the company has taken over from the General Electric Co. 38 German and 85 foreign patents. Moreover, the German company further receives from the General Electric an option on all applications on the part of the latter for patents in America, with the right to take out patents on these throughout Europe. A German syndicate has entered upon negotiations with Mr. Edison in New York with a view to founding a company in Germany, with Mr. Edison as a director, for taking over Mr. Edison's new patent accumulators for automobiles."

Annual Dinner.—The second annual dinner of the Gauge and Inspection Department of the Electric and Ordnance Accessories Co., Ltd., was held on Saturday last, at the Colonnade Hotel, Birmingham, and a smoking concert followed.

"Cyclone" Engines.—Messrs. Matthews & Yates, Ltd., of Swinton, near Manchester, are just placing upon the market a new type of small engine, known as the "Cyclone" high-speed enclosed forced-lubrication type. It is intended for driving their induced draught fans and dynamos. A detailed specification of these engines is given in a 20-page pamphlet just issued by the company, and a copy will be sent to engineers who may be interested in the subject.

St. Louis Awards.—Messrs. Pirelli & Co., of Milan, have obtained at the World's Fair at St. Louis a grand prize in the group for india-rubber goods in general, and two gold medals for insulated wires and cables. Special medals were also awarded to the firm's factory superintendents, Mr. Emilio Calcagni and Mr. Francesco Piazza, and to its secretary, Mr. Carlo Fratino; also a gold medal to the chief electrician, Ing. Emanuele Jona, for a paper read before the International Electrical Congress on "Insulating Materials in High-tension Cables."

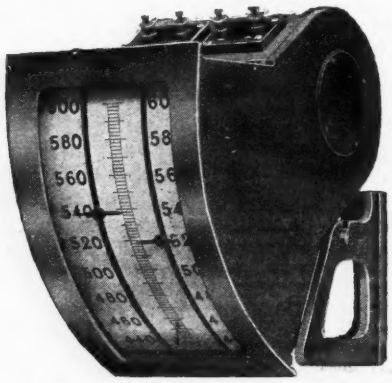
Trade Announcements.—Mr. Robert W. Paul asks us to state that on account of the increase in electro-technical correspondence addressed to his Holborn office, and often involving reference to the works, all communications relating to electrical and scientific instruments and materials should be addressed to him at Newton Avenue Works, New Southgate, London, N. The premises at 68, High Holborn, will continue to be open for personal interviews by appointment, and as showrooms for electrical instruments.

The registered office of the Newcastle-upon-Tyne Electric Supply Co., Ltd., has been removed from 50, New Bridge Street, to Royal Exchange Buildings, Newcastle-upon-Tyne.

Messrs. W. Ferguson (late foreman engineer at the Westinghouse Co.'s works) and A. Robinson have commenced business at 1, Cross Street, near Market Hall, Birkenhead, as electrical engineers.

Steel-car Building.—The American Car and Foundry Co., which recently secured a contract from the Underground Electric Railways Co. of London, Ltd., for steel passenger cars, has placed an order with Messrs. John Macdonald & Son, of Glasgow, for the whole of the pneumatic equipment required for building them.

Duplex Station Voltmeters.—Messrs. Evershed and Vignoles, referring to a recent description in our pages of a station voltmeter for paralleling and similar purposes, wrote to us, too late for publication last week, to draw our attention to the Duplex voltmeter which they have been making for some years, and in which the advantages of having the scales close together, they think, are even more fully realised. In their pattern, the two movements are mounted on either side of a central framework, and one case only is used. These two movements are electrically entirely independent, but are placed in such a position that the two pointers work over the



same scale. In this manner the tips of the pointers come within a fraction of an inch of one another at the moment when the voltage applied to each instrument is the same, and any difference in voltage, even of a fraction of a volt, is obvious, even at great distances. In the instrument illustrated herewith, the scales are vertical, but, of course, the instrument can be arranged to be placed in a horizontal position, if required. As these instruments have been in use in central stations for some years, Messrs. Evershed and Vignoles think it can hardly be claimed that the somewhat similar arrangement adopted by another maker "is a distinct advance on instruments which have appeared hitherto," as suggested in our descriptive paragraph.

Book Notices.—"Practical Advertising" is a comprehensive volume containing some 700 pages of matter, which cannot fail to be of use to anyone interested in advertising. It is provided with a comprehensive index, and is divided into sections comprising London and Suburban Publications, Provincial Publications, Magazines, &c., Colonial Papers, a section on Advertising Rates, and a list of bill posters in the United Kingdom. It also contains throughout numerous examples of successful advertising, as carried out by the publishers, Messrs. Mather & Crowther, Ltd., 10—13, New Bridge Street, E.C., and we have no hesitation in recommending its acquisition for the office bookshelf.

"Chemical Statics and Dynamics," By J. W. Mellor. London: Longmans, Green & Co. 7s. 6d.

"Bulletin of the United States Fish Commission." Vol. XII., for 1902. Washington: The U.S. Department of Commerce and Labour.

A small brochure has reached us from the Buenos Ayres and South American Agency, of Mansion House Chambers, E.C., entitled, "British Trade with South America." It is written by Mr. Pedro A. Costa, of Buenos Ayres, and gives some details of the economic conditions of the South American Republics for guiding manufacturers who may wish to defend or develop their businesses in those countries. The commercial traveller and his fitness and other matters are briefly covered, and there is a short index to banks, hotels and shipping companies, publications, &c.

"Die Asynchronen Drehstrommotoren." By Dr. Gustav Benischke. Braunschweig: Friedrich Vieweg & Sohn. M. 5 50.

"Traité Théorique et Pratique d'Electricité." By H. Pécheux. Paris: Librairie Ch. Delagrave. Paper covers, 17 fr.; cloth covers, 20 fr.

Having met many young men starting in the electrical business without complete technical training, Mr. E. B. Raymond, of the New York General Electric Co., has written a complete hand-book, "Alternating Current Engineering," which deals, first, with the general laws of magnetism and alternating currents; and, secondly with modern alternating apparatus and methods of testing. It will shortly be issued in London by Messrs. Kegan Paul.

"Electricity Control: A Treatise on Electric Switchgear and Systems of Electric Transmission." By Leonard Andrews. London: Chas. Griffin & Co. 12s. 6d. net.

Handy Book of Logarithms. London: Blackie & Son. Price 2s.—This handbook contains tables of 6-figure logs of numbers from 1 to 10,000, with differences; hyperbolic logs of numbers from 1·01 to 30; tables of diameters, circumferences, powers and roots, lengths of circular arcs, natural and logarithmic ratios, reciprocals, &c., all neatly arranged and clearly printed. In an Appendix a series of practical problems are given relating to geometry and mensuration. The uses of the various tables are given in a brief introduction. Works of this kind, being indispensable, need no recommendation; we may add, however, that this one is strongly bound—an important consideration.

"Modern Electrical Practice." Edited by Magnus Maclean. Vol. V. London: The Gresham Publishing Co. 9s. net.

We have received a copy of the first number of *The Auction Index and Record*, a penny weekly publication, in which is well arranged a list of forthcoming auction sales throughout the United Kingdom, giving a note of the class of property to be offered, the date and place of sale, and the name of the auctioneer. This should be useful to engineering and other firms who are anxious to see what are "going" in the way of buildings, plant, machinery or electrical apparatus.

LIGHTING AND POWER NOTES.

Burton-on-Trent.—On the recommendation of its Gas and Electricity Committee, the T.C. has decided to give rebates for private lighting quarterly instead of half-yearly on the maximum demand system, and also to charge an alternative flat rate of 5d. per unit. A reduction in meter rents was also approved, the rent per quarter now varying from 2s. for 10-ampere size, in place of 3s. 6d. previously, other sizes being reduced in proportion.

The total number of units sold during the six months ending September 30th last is:—Lighting and power, 105,361; traction, 296,989; total, 402,350; the increase in lighting being 18 per cent., and in the total 146 per cent. The number of consumers amount to 358 and the H.P. of motors connected, 130; the equivalent in 8-C.P. lamps being 27,771 as against 23,462 for the same period last year.

Bury (Lancs.).—The Electricity Committee has recommended the T.C. to apply for a loan of £30,000 for general electricity purposes, including additional plant at the works. The present equipment is being used to the utmost capacity.

Castleford.—The B. of T. has informed the U.D.C. that it will defer consideration of the question of rescinding the E.L. prov. order for a year, but unless active steps have been taken at the expiration of that period to establish works, the order will not be allowed to remain in force.

Church Stretton.—The E.L. installation of the Church Stretton Land Co. was inaugurated by Mrs. Harold Mostyn, wife of the chairman of the company, on the 14th ult. The whole of the work has been carried out by Messrs. Drake & Gorham, Ltd., with the exception of the Dowson gas plant. The installation consists of two 80-H.P. gas engines, each driving a 50-KW. generator. The three-wire system of distribution has been adopted, the pressure on the outers being 400 volts. A battery of 214 cells has also been installed, and small armoured cables have been laid throughout the town.

Dunstable.—Mr. L. A. Waterfield, residing in West Street, has recently put down a small plant for lighting his house by electricity. The installation has been erected at some distance from the house, and lead-covered cables run underground. The plant consists of a 7-H.P. Crossley gas engine, driving by belting a small Holmes "Castle" generator; a battery of E.P.S. cells, capable of taking the whole load for about five hours and accessories. The installation was carried out by Messrs. Garrett Bros. & Co., of Dunstable.

Dartford.—The U.D.C. has adopted a flat rate of 5d. per unit.

Dover.—The T.C. has adopted the prepayment meter system, by which a supply of current for an 8-C.P. lamp for about 32 hours, or for a 16-C.P. lamp for 16 hours, is obtained for 6d.

Dumbartonshire.—At a meeting of the County Council on Friday last, it was reported that negotiations were still proceeding with the Caledonian Water Power Electricity Co., as to their scheme for generating electricity at Loch Sloy. With regard to the proposed tramways from Clydebank to Balloch, the promoters wrote that some of the suggestions made by the County Road surveyor, were properly town improvements, and the company should not, therefore, bear the entire expense. Both matters were left in the hands of the sub-committee.

East Ham.—On 25th ult. a L.G.B. inquiry was held relative to the application of the U.D.C. for a loan of £10,320 for E.L. purposes. There was no opposition.

Erith.—The U.D.C. has offered to supply energy to Messrs. Callender's Works at 6d. and 1½d. per unit, subject to the following discounts:—25,000 and under 50,000 units per quarter, 9 per cent.; 50,000 units and over, 18 per cent.

Edmonton.—At a special meeting on November 24th, the U.D.C. considered the offers of the North Metropolitan Electric Power Supply Co., the Industrial Engineering Co., Messrs. Foote & Milne, Ltd., and the National Construction Co., Ltd.—Mr. Hawes, of Messrs. Hammond & Son, made an exhaustive report on the offers. He explained that that from the North Metropolitan Co. was practically an offer to take over the Council's powers and to work the undertaking on its own lines, the Council not to have the privilege of purchasing it until after the expiration of 26 years. Energy would be supplied from one of the company's power stations to a transformer station in the district, and would be distributed on the three-phase system. That might be a disadvantage to the Council when it acquired the undertaking, the district being eminently suitable for a D.C. supply. The company limited the mains at the start to the compulsory area, whereas he did not think the Council would do so, if it established the works. The charges for energy quoted by the company were reasonable both for lighting and power, and also for public lighting, provided that the latter included maintenance, the Council having the option of considering the revision of the tariff every seven years. The company were willing to divide the net profits after taking 5 per cent. upon the whole of the capital involved, which he supposed would mean after also paying directors' fees. The other three offers were for the execution and maintenance of works. Messrs. Foote & Milne, Ltd., offered to maintain the undertaking for 25 years, and to give the Council certain conditions of purchase up to 15 years. After six months' notice they were prepared to transfer the undertaking to the Council upon it paying any loss which they might sustain plus 4 per cent. interest, but less 4 per cent. on any surplus profits which they might make beyond the amount of the interest and sinking fund which they would have to pay to the Council. They did not state the prices for energy supply. The Industrial Engineering Co.'s offer was conditional upon the Council laying down gas-driven dynamos, and upon all the plant being manufactured by the company. They further agreed to work the undertaking for only five years, and under their terms, if the Council decided to take it over within that period, they would practically have to guarantee them a gross profit of nearly 10 per cent., which would be an extraordinary yield. The offer from the National Electric Construction Co. deserved the Council's consideration. They were prepared to tender for the complete works to the Council's own specification, and they required a bonus of 5 per cent. on the net price of the tender. They agreed to maintain for 25 years, and give the Council the option of purchase at 7, 10, or 15 years—at 7 years on the basis of the payment of a bonus of 12 per cent., at 10 years of 7½ per cent., and at 15 years of the exact amount of the capital expended. They agreed to divide all the profits beyond 3 per cent. if the option to take over, at 7 or 10 years was not exercised. Their prices were distinctly favourable—flat rate 5d. per unit, maximum demand rate 7d. per unit for the first hour and 2d. afterwards. For power they quoted a sliding scale. Mr. Hawes also dealt with an offer from the North Metropolitan Co. to supply in bulk. Their prices worked out at about 2·37d. per unit for maximum demand supply for 200 hours, and 2d. per unit for every day supply of the year for 300 hours. His firm did not see how the Council could afford to pay for a bulk supply at a price exceeding 1·14d. per unit. Failing an offer approaching that figure, the Council should devote their attention to the tender of the North Metropolitan Co. to take over the Council's powers, or to that of the National Electric Construction Co.—A long discussion ensued, but was adjourned.

Germany.—An electricity works is to be established in connection with the Prinz Regent Collieries at Wiemelshausen, Westphalia, for lighting and power purposes.

Goole.—The B. of T. has deferred the consideration of the question of revoking the Council's E.L. order for a year.

Greenock.—The T.C. has resolved to increase the electrical energy supplied to the District Tramway Co., from 500,000 to 600,000 units per annum, the company to pay for the additional 100,000 units at 1½d. per unit. It was also agreed that the company should have the use of the existing spare cable-conduits at a rent of 3d. per yd. per annum for each way.

Heckmondwike.—The U.D.C. is promoting a Bill in Parliament seeking powers to supply current outside the district, and to deal in lamps, meters, motors, and fittings.

Hemsworth.—The local Electricity Supply Co., Ltd., is seeking powers to supply energy to Hemsworth, Wintersitt, Ryhill, Havercroft, South Hundley, Shafton, Brierley, South Kirkby, South Elmsall, North Elmsall, Upton, Badsworth and Ackworth.

Holyhead.—A L.G.B. inquiry was held on November 23rd, relative to the U.D.C.'s application for a loan of £1,000 for E.L. purposes. There was no opposition.

India.—Madras.—At the municipal meeting held a short time ago, the Committee's report on Messrs. Crompton's and Messrs. Burn & Co.'s applications for licences for the electric lighting of the city was considered, and decided in favour of that of Messrs. Crompton & Co., but it advocated a reduction in the period when the municipality could exercise its option of purchase from 42 to 21 years, renewable thereafter every seven years. The report was adopted, and forwarded to Government, laying stress on the necessity for demanding security for the due fulfilment of the contract.

Inverness.—The T.C. has agreed that Messrs. Buchan and Hogarth should be appointed annually, for the next seven years to make the annual inspection of the works, but the Council undertook no responsibility as to the fee to be paid.

Liversedge.—The U.D.C. has requested the Electricity Committee to get out a draft scheme for E.L., based on the report of Messrs. Chas. Gott & Sons.

London.—Battersea.—It was reported by the Lighting Committee that the agreement entered into with the County of London Electric Supply Co., Ltd., relative to the supply of electrical energy in areas transferred under the provisions of the London Electric Lighting Areas Act, 1904, had been confirmed by the Board of Trade. The estimated cost of the combined schemes was £5,900, and the net amount to be paid to the company under the agreement in respect of consumers in the transferred areas was approximately £600, and the Committee ask the Finance Committee to submit an estimate for the total amount, viz., £6,500. As the Council was required to be in a position to supply electrical energy in the transferred areas by January 1st, 1905, the Committee recommended that the work should be commenced at once.

Bethnal Green.—The B.C. decided, at a special meeting on November 24th, to carry out the electric lighting scheme at an estimated cost of £80,000.

Camberwell.—The Works and G.P. Committee has resolved to support the suggestion of the L.C.C. regarding the allocation of the capital of companies between areas of the various local authorities in which the company is operating. It was also agreed to approach the B. of T. in the matter.

Hackney.—Consumers of electrical energy changing from flat rates to the M.D. system of charging, and prospective consumers who have had no experience of sliding scales, seem to experience difficulty in estimating the average price per unit which they will be called upon to pay. Since the E.L. Committee decided to apply the sliding scale system at Hackney, Mr. L. L. Robinson, its borough electrical engineer, informs us that he has been inundated with letters asking for help in this direction. Mr. Robinson has, therefore, sent a letter to each of the local papers setting forth a very simple method by which the average price per unit for any class of supply can be worked out easily by anyone of ordinary intelligence. The "tip" may be of use to other engineers in similar circumstances.

Stoke Newington.—A special meeting of the B.C. was held on Tuesday evening to consider reports (summaries of which have already appeared in this paper) with respect to electric lighting. Dr. White, chairman of the Electricity Committee, moved without comment the adoption and sealing of the agreement with the North Metropolitan Power Supply Co. Several Councillors objected to this mode of procedure, and Dr. White then went fully into the subject. The tender of the North Metropolitan Co. was so very much better in every way than the others received, that nothing could be done but recommend it for acceptance. Energy was to be supplied by the North Metropolitan Co. in bulk, and Messrs. Talbot and Stevenson, the Council's consulting engineers, estimated that every unit sold would cost the Council in bulk 2·16d. It was proposed by the Committee to expend at first £22,560, as follows:—Cost of site for transforming station, £525; building, £2,400; transforming plant, £3,500; battery, £1,000; 100 house services at £6 each, £600; mains, £9,550; contingencies at 10 per cent. on the foregoing items would bring the total to £19,330. Then there would be engineering, £730; and, finally, an amount of £2,500 already spent in High Street, interest and sinking fund on £22,560 would be £1,580 a year, and salaries and wages and maintenance were estimated at £1,020 per annum. To meet this and pay the bulk supply at 2·16d. per unit, there would have to be sold each year at the present charge of 5d. per unit, 220,000 units. The consumption in the borough now, without public lighting, was 80,000 units. But the great point he wished to impress upon the Council was that if there was any loss the company would bear it. After a long discussion, it was decided with only two dissentients to adopt and seal the agreement with the North Metropolitan Electric Power Supply Co. Dr. White said this was the fruition of four years' work. The Board of Trade was accountable to a large extent for the great delay.

Westminster.—The Works Committee of the Council, reporting on Tuesday, stated, with reference to the correspondence with the Charing Cross and Strand Electricity Supply Corporation *re* the proposed construction of boxes, that further negotiations had taken place.

Maidenhead.—A L.G.B. inquiry was held on November 23rd, into the application by the T.C. to borrow two sums of £3,500 each for the purpose of electric lighting extensions in the borough, and in Bray, Cookham and Taplow.

Mexico.—A concession has been granted to utilise the water-power of the River Angulo, in Michoacan, for generating electrical energy. It is stated that about 20,000 H.P. is available.

Norwich.—The E.L. Committee has decided to reduce the charges for electricity for lighting purposes from 5d. to 4½d. per unit, from May 1st next.

Retford.—On Friday last a special meeting of the T.C. was held to consider the proposed E.L. scheme, which provides for supplying 100 consumers at a capital expenditure of £5,375. There was strong opposition, and the scheme was negatived by 16 votes to four.

Sligo.—A special meeting of the T.C. was held on November 30th to consider the application for a concession in connection with electric power and lighting in the borough.

South Wales.—The Cardiff Railway (Bute Docks), Taff Vale Railway (Penarth Docks), Barry Railway (Barry Docks), and Alexandra Dock and Railway (Newport) Companies have forwarded objections to the Home Secretary in regard to the recently issued Factory Act regulations as applied to generation and distribution of electricity in dock undertakings. At present many miles of overhead wires exist at Cardiff, Barry and Penarth Docks, as to which the regulations do not appear to be applicable.

Southend.—On November 22nd a L.G.B. inquiry was held relative to the Corporation's application for a loan of £56,000 for the extension of the E.L. plant and the provision of additional mains. There was no opposition.

Stourbridge.—The Electric Lighting Committee considers it desirable that a deputation should wait on the L.G.B. in regard to the proposed agreement for taking electricity in bulk. It was suggested that the Power Co. had not the necessary powers to supply to the Council, and another company had included the town in its area.

The Steel Industry.—Large electric power installations are to be put down to drive the whole of the plant and machinery at the extensive steel works of Messrs. Bell Bros., and also at the iron and steel works of Messrs. Dorman, Long & Co., Port Clarence, near Middlesbrough.

Whitwood.—The U.D.C. has decided to apply to the B. of T. for a prov. order for E.L.

Willesden.—The solicitor to the U.D.C. reported that notice of appeal had been given in the case, Attorney-General *v.* Metropolitan Electric Supply Co. Instructions were given to take all necessary steps to support the judgement of Mr. Justice Farwell.

TRAMWAY AND RAILWAY NOTES.

Ackworth and Lindsey.—Messrs. R. E. C. Shann, W. F. Tempest, and F. Hopper are applying to the Light Railway Commissioners for powers to construct six lines of electric tramways.

Belfast.—The L.G.B. arbitrator, Mr. L. S. Macassey, has intimated to the Corporation, that for reasons of economy and convenience, the tramways arbitration will be held in London. The B.E.T. Co. has asked the Corporation for terms and conditions for supplying current to the Cavehill and Whitewell lines.

Burton-on-Trent.—The figures for the working of the Corporation tramways for the six months ended September 30th last are: for traffic receipts, £9,671, which, together with the sum of £272 for sundries, make the total revenue of £9,943; the car mileage run was 229,634; traffic receipts per car-mile 10·11d.; passengers per car-mile, 9·31d., the average receipts from each being 1·08d.; the total number of passengers carried amounted to 2,139,873, or equivalent to 41·15 times the population. The units used for driving purposes amounted to 300,052, or 1·306d. per car-mile.

Bury.—At a meeting of the Tramway Committee on 25th ult. decided to adopt a system of collecting and delivering parcels in connection with the Corporation tramway system. Under the scheme parcels may be handed to the conductors of any cars travelling to Bury at any of the authorised stopping places, or they may be left at the Central Offices, Market Place, and will be delivered at an inclusive charge within half a mile on any part of the system, while for an extra charge parcels will be collected within half a mile of the system. The scheme commenced on December 1st.

Cambridge.—Owing to the non-completion of the negotiations for the purchase of the undertaking of the Cambridge Street Tramways Co., the Cambridge Electric Tramway Syndicate, Ltd., has decided not to proceed with the application for powers to extend and electrify the system until next year. Any electrical man visiting Cambridge will admit that its tramway system is a truly remarkable affair.

Canal Electric Railway.—It is reported that a scheme is on foot to construct an overhead electric railway above the Regent's Canal, and that a number of American capitalists are interested in promoting the undertaking.

Dewsbury.—Our local correspondent writes:—"When the B.E.T. Co., who have already constructed tramways from Dewsbury to the Spen Valley and other places, bought out the shareholders of the Dewsbury and Batley Steam Tramways Co., it was understood that this line would be electrically equipped without delay. Bradford Road, on which the trams run from Dewsbury to Gomersal, is the busiest thoroughfare in the heavy woollen district, and complaints are many respecting the present inadequate service. It is about 30 years since the line was opened, and both cars and rails are considerably worn. There are frequent stoppages. The Traction Co. have come to an arrangement with all the local authorities through whose area the line runs, except Batley Corporation. Until an agreement is come to with Batley, the work of reconstruction cannot be taken in hand."

Dundalk.—On the 23rd ult., a sitting of the Judicial Committee of the Privy Council held at Dublin Castle, considered an application for an Order extending the time fixed for the completion of the tramways authorised by the Dundalk Electric Tramways Order, 1897.

Mr. Healy, K.C., said the application was one for an extension of time for two years from November 1st. He agreed that they had been a little slow in the matter, but the delay was entirely due to the condition of the money market. He guaranteed, however, that this was the last application they would make to the Council. The line would run from Dundalk to Blackrock, a pretty little watering place in the North of Ireland.

The application was granted.

An application was also considered for an Order in Council authorising the construction, maintenance and working of tramways or railways proposed to be laid in the Urban District of Wicklow, and to confirm the resolution of the Wicklow Urban District Council with respect to the said tramways.

The only parties who had intimated any opposition were the National Telephone Co., who required protection clauses.

The application was granted, an agreement having been come to for the insertion of a clause or clauses in the order safeguarding the position of the Telephone Co.

Glasgow.—Lord Balfour of Burleigh's award in the arbitration between the T.C. and the Paisley and District Tramways Co., to decide the amount payable to and by the Corporation in connection with the running of cars between Hawkhead Road and Paisley Cross, was issued on Tuesday. His Lordship's findings are:—

(1) The tramway company to receive £250 from the Glasgow T.C. on December 1st, 1904, for constructing the sidings. (2) T.C. to pay the company whole fare received from local passengers, and two-thirds of a penny for each "through" passenger. (3) T.C. to receive from company 3½d. per car-mile for working expenses. (4) Extra expenses, checking tickets, &c., to be borne equally. (5) Award to last till December 31st, 1914. (6) Expenses incidental to the arbitration to be borne equally, and *quo ad ultra*, each party to pay its own expenses. To the sum of 3½d., which will be allowed to the Corporation for working expenses, there will fall to be added the cost of the electric current which is supplied by the Paisley Town Council.

The Sub-Committee of the Corporation tramways, which was appointed on April 27th last to consider a mechanical trolley car designed by a foreman linesman in the department, has prepared a report. The car has been in operation on the tramways for a year, and the Committee recommends that the Corporation bear the cost of the provisional protection of the car for four years on the conditions that the Corporation will, free of all charge for royalty, be allow to use the car on its system; that should the patent rights be allowed to lapse, or should the Corporation determine to discontinue the use of the car at the end of the four years, it will not be held liable for any further payments in connection with the renewal of the patent, and that should the Corporation continue to use the car after the expiry of four years, the Corporation undertakes to pay its patent fees so long as it uses it on its system.

A special sub-committee has been appointed to consider the question of providing workmen's weekly tickets on the same principle as that in operation by the various railway companies in the city.

In view of the large number of unemployed in the City, the general manager has received instructions to proceed with the work of constructing the tramway authorised last year from the present terminus at Pollokshaws (East) to Siffnoch. The manager has been asked to advertise for the necessary material.

Liverpool Overhead Railway.—The laying of the third rail between Seaforth (Lancs. and Yorks.) Station and the northern terminus of the Overhead Electric Railway was commenced on the 19th ult. By means of the junction of electric lines already substantially effected, trains will early next year be run from the Dingle to Waterloo, Formby, Southport, Crossens, and the intermediate stations.

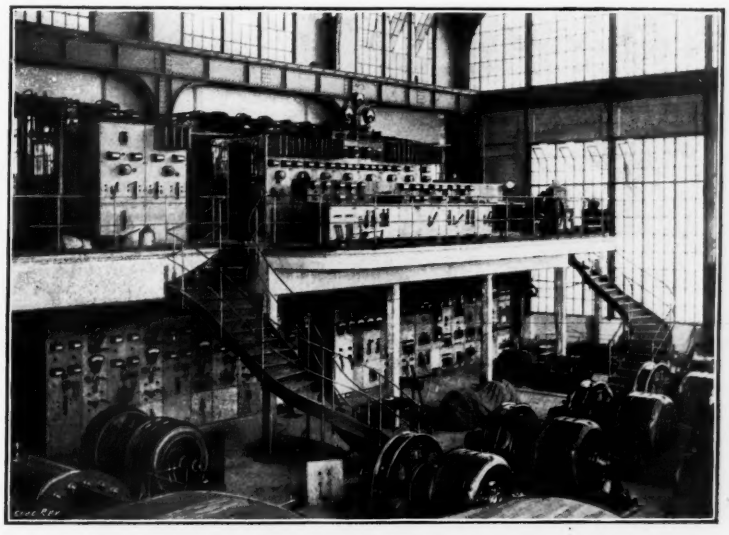
South Shields.—The Tramways Committee on 24th ult. considered the question of proceeding with the laying of the tramways. The first proposal, it is understood, was that the Corporation should obtain tenders at once for the construction of the new route from Westoe Lane *vid* Meldon Terrace, Laygate Lane, Frederick Street, South Eldon Street, to Tyne Dock. Another proposal was that the Committee should wait for the expiration of the present lease before commencing any of the work, and a third suggestion was that the Corporation should buy out the B.E.T. Co. who hold the present lease. Our correspondent learns from a usually reliable authority that the buying-out suggestion was hardly ever seriously entertained, but there was almost unanimity in the proposal to put in hand such parts of the work as they could under existing conditions. So that, although they could not work the trams to Tyne Dock until expiry of the lease, yet it should be pushed forward so that it would be ready when the lease does expire. The Committee also commenced the consideration of the question of providing adequate car-sheds, but it was not carried beyond the appointment of a sub-committee, and an instruction to the town clerk to present a report on the matter.

(*Continued on page* 912.)

PARIS—ORLEANS ELECTRIC RAILWAY EXTENSION.

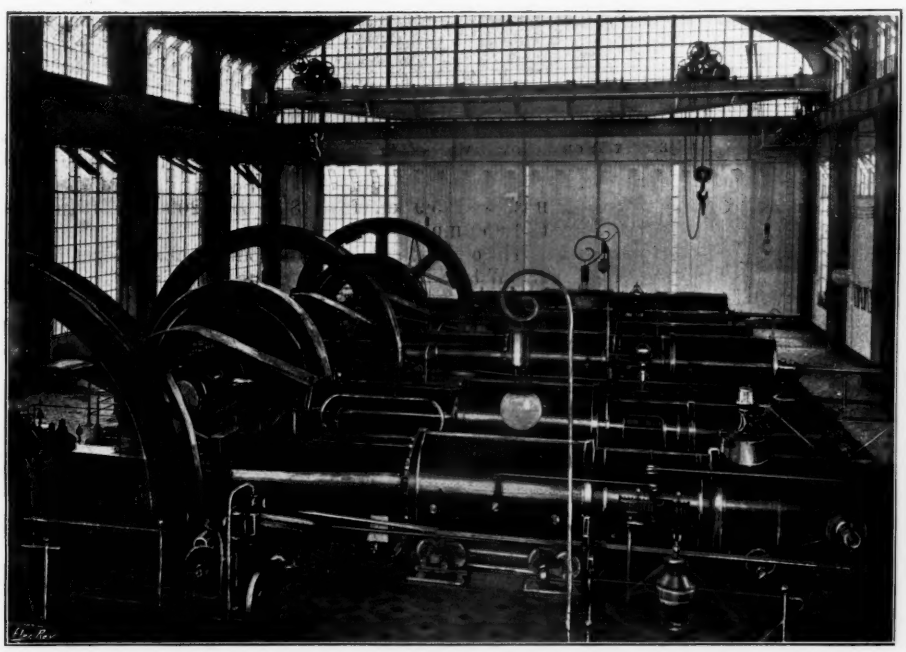
The Paris-Orleans Railway Co. commenced their train service by means of electric traction in May, 1900, at a time when electric railways, if not in an experimental stage, were at all events looked upon from many sides as an expensive luxury beyond the pale of practical everyday main trunk lines. When the installation was designed, the only similar railways in existence were equipped with small trains for suburban traffic, hardly comparable with the system in question.

The confidence of the Paris-Orleans engineers, however, was such that there was no half-hearted advocacy of the electrical installation, and the design provided that possible extensions could be easily made. The same policy of foresight has characterised the new extension, especially in respect of the provision of apparatus for use on a circuit, the voltage of which will eventually be 11,000, although 5,500 volts is the highest at present in use. The present installation has given the fullest satisfaction to the railway company.



Main Switchboard in Power Station; Sub-station and Lighting Switchboards Below.

It may be useful to recall the circumstances which led to the adoption of electric traction. Owing to the spread of the city westward, it was necessary to provide a more central terminus in Paris for their main and suburban traffic, and the Orleans Railway Co. were fortunate in finding an excellent site on the bank of the Seine, almost a stone's throw from the Chamber of Deputies. The distance from the old terminus of Austerlitz to the new station of Quai d'Orsay is about 2½ miles, and this is mostly in a subway. The new terminus was provided with 15 tracks, converging into two, which continue as far as the old Austerlitz Station. The train service amounted in the summer to as many as 150 trains daily. The most economical solution of the problem would, of course, have been to continue the haulage by steam locomotives as far as the new terminus. This, however, was not found to be possible, ventilation and other difficulties barring the way. Thus the conditions were altogether special, and a comparison of costs of electric traction could only be made with a system of traction by locomotives emitting neither steam nor smoke.



Generating Plant at Ivry Power Station.

Dealing with the 1900—1904 service, on the average 140 trains have arrived daily at the (old) Austerlitz station, ranging in weight, exclusive of locomotive, from 150 up to a maximum of 300 tons. These trains arrived at Austerlitz Station behind regular steam locomotives, and an exchange was made (the time required was 2 minutes) from the steam to the electric locomotives, in tow of which they proceeded through the tunnel to the Quai d'Orsay terminus, and *vice versâ*. The distance between the stations is 2·4 miles, and the majority of the trains made a one-minute stop at the intermediate station of St. Michel. The electric locomotives drew the heaviest trains between the two termini in eight minutes.

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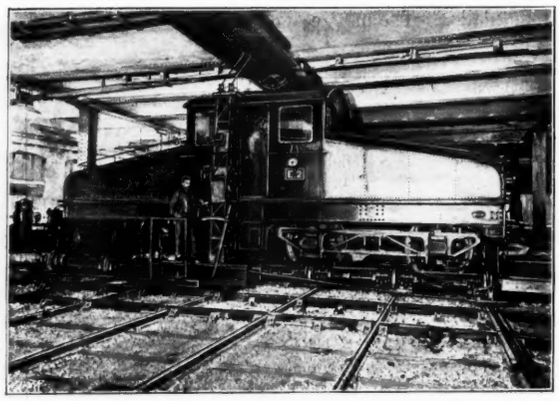
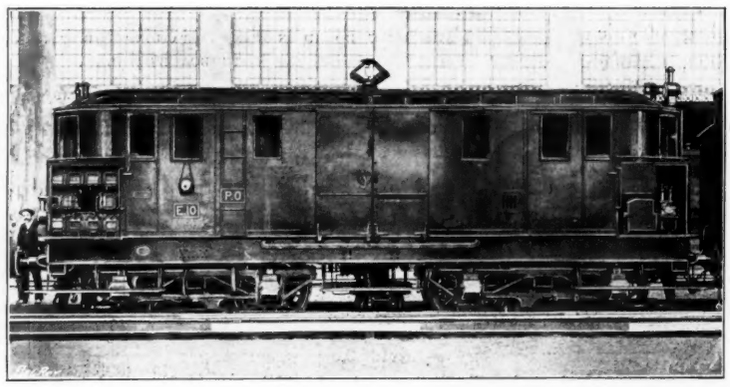
The rolling stock provided included eight electric locomotives, each weighing about 50 tons, and equipped with four 225-H.P. motors, one on each axle of the two bogie trucks. The appearance of the locomotive is shown in the



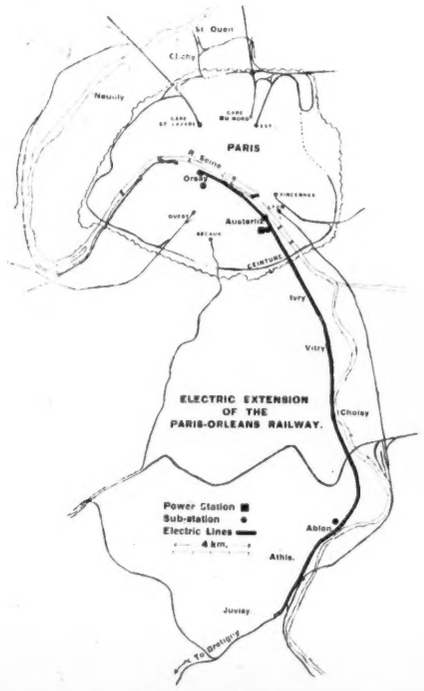
Electric Locomotive, Original Type.

accompanying illustration. It consists of a central steel cab with sloping ends, mounted on a channel framework and carried on two swivel trucks of specially heavy build. The principal dimensions are as follows:—Length over all, 34 ft. 10 in.; width over all, 9 ft. 7 in.; height above rails, 12 ft. 9 in.; distance between truck centres, 16 ft.; wheel base (each truck), 7 ft. 10 in.; diameter of drivers, 4 ft. 1 in.

The motors are of single-reduction railway type with nose suspension. The gear ratio of 4·1 to 1 was adopted, but this has been altered for the new service, as will be seen later.



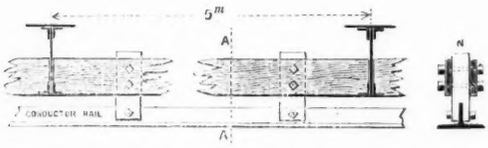
New Type of Locomotive.



Map of Route.

The controller is of the series-parallel type. Included in the electrical equipment of the locomotive are the usual air compressors, sanding devices, instruments and switchgear.

The third-rail system supplied current at an average pressure of 575 volts (now 600), and the locomotive is furnished with four shoes for contact with the rail, which is situated outside the track. In certain parts of the route the side-rails are supplemented by short stretches of centre rail, and suitable insulated contacts are provided on the motor frames.



Elevation and Section of Overhead Rail.

At other points, where third-rail construction is too complicated, an overhead conductor of inverted "T" iron has been provided, and the locomotive carries an overhead shoe, as seen in the figure.

The generating system included two groups (now three) of 1,000 KW. each, erected at Ivry power station, close to the Austerlitz terminus. The three-phase current is produced at a pressure of 5,500 volts, 25 cycles. Each dynamo has 40 poles, and runs at 75 r.p.m. The engines, built by Dujardin, of Lille, are horizontal four-cylinder 1,700 H.P. Corliss type, two of the cylinders running at low pressure. A maximum of 1,850 H.P. can be obtained. Condensers are fitted in the basement.

The fly-wheel is 55 tons in weight, and 24 ft. 7 in. in diameter. The guaranteed consumption of steam is 5·3 kg. per I.H.P.-hour from 1,200 to 1,500 H.P., and 5·9 kg. from 800 to 1,200 and from 1,500 to 1,850 H.P.

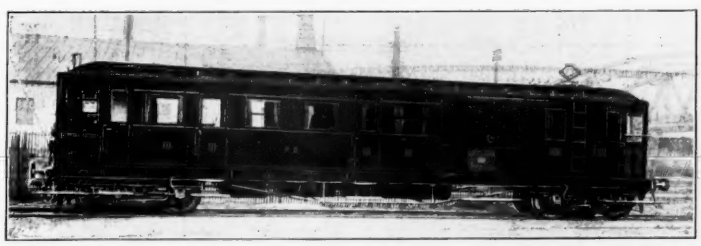
The original installation of boilers included eight Babcock and Wilcox boilers in two groups. This boiler plant has since been increased by the addition of four boilers of larger

Terminus at Orsay.

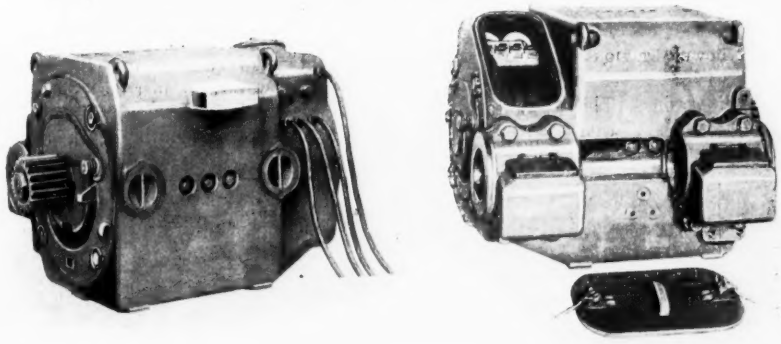
capacity. In normal working each new boiler is capable of producing 2,200 kg. of steam per hour at 185 lbs. per sq. in.; by forcing, this can be raised to 2,800 kg. Green economisers and Meldrum stokers were provided. The latter have now been replaced by a complete installation of Bennis

stokers, which were placed in service at the same time as the new boilers were erected for the extension.

The two sub-stations first provided—one at Quai d'Orsay, and the other at Austerlitz—were distant respectively 3¼ miles and 1 mile from the power plant. They each included two sets of machines—one for traction, and the other for lighting. The latter consist of synchronous motors taking high-pressure current direct from the 1,000-KW. groups in the power station. The output of these motors is 125 KW., speed 500 r.p.m., and they are coupled to 100-KW. dynamos supplying a five-wire lighting circuit, which is in use throughout the installation. The efficiency of these machines is below that of the rotary converter, but the advantage of a constant pressure produced by the dynamo independent of the load on the plant is considered sufficient to justify their use.

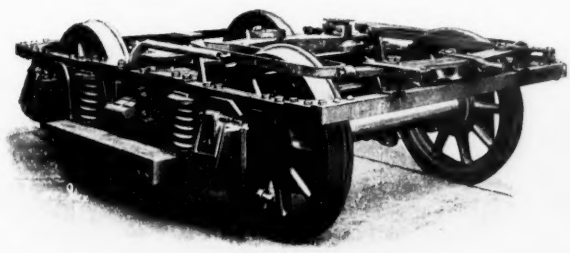


Motor Car.



Motors used on Locomotives.

For the traction circuit were furnished in each sub-station two groups of three 100-KW. air-blast type transformers, transforming from 5,500 to 340 volts three-phase, two potential regulators, two groups of self-induction coils, and a set of storage batteries of 260 cells, 1,100 ampere-hours capacity. Two four-pole rotary converters of 250-KW. output transform the 340 alternating current voltage to 550 volts continuous. These converters run at a speed of 750 r.p.m. The pressure can be varied from 525 to 575 volts. The starting is done by means of the storage batteries, which are usually connected in parallel with the traction circuit.



Motor-car Truck.

One of these two sub-stations has now been abolished and new sub-stations created. The rotary converters have always been run with series winding in opposition to the shunt, and, it is stated, have never given the least trouble. The average voltage on the third rail in the vicinity of the power station has been 550, and the compounding of the rotary converters is so arranged, that at about 350 amperes output the voltage is 575, and at the maximum load the voltage is 525. This may give an idea of the reverse compounding curve of the machine, which, of course, passes through these two points of 350 amperes 575 volts and 650 amperes 525 volts.

Whenever it has been necessary to de-sulphate the battery, calling for an increase of the voltage to about 700, a potential regulator has been used. Naturally this entails a considerable lagging current, but as the charging is usually done in the small hours of the afternoon, when there is but a small lighting and traction load, it is not a matter of great moment. The de-sulphating is only done about every 10 days or so. Whenever this high voltage is required, the output of the rotary does not exceed 200 amperes, and it has been found possible to obtain this voltage without modifying the series winding of the rotary, or throwing it over so that it acts with the shunt winding. The use of reversible boosters has been avoided by this method of connection.

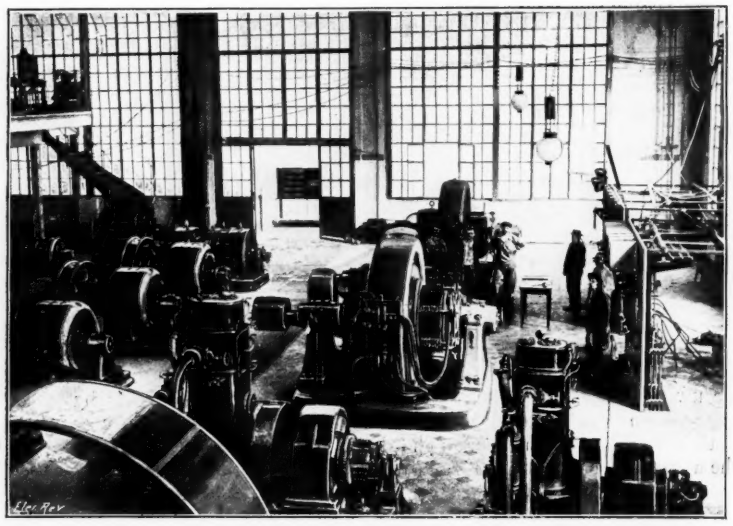
In addition to the motor-generator groups there are a number of balancers consisting of four machines coupled together. Some of these have 5 KW. armatures, and others 10 KW., and they are rated as 4 × 5 KW. and 4 × 10 KW.

A few figures relating to the locomotive service may be quoted. The tractive effort developed by one of the locomotives before the 4 to 1 gear ratio was changed, in hauling trains of from 200 to 260 tons at 25 km. per hour, was 2·4 kgs. per ton, and at 50 km. per hour, 4 kgs. per ton.

End of Motor Car.

The watt-hours per ton-kilometre, at a speed averaging 28 km. per hour, including five stops, when hauling trains of 200 to 260 tons, were 22. The measurements were made over a run of 7·5 km., and suppose an average voltage of 500 at the locomotive.

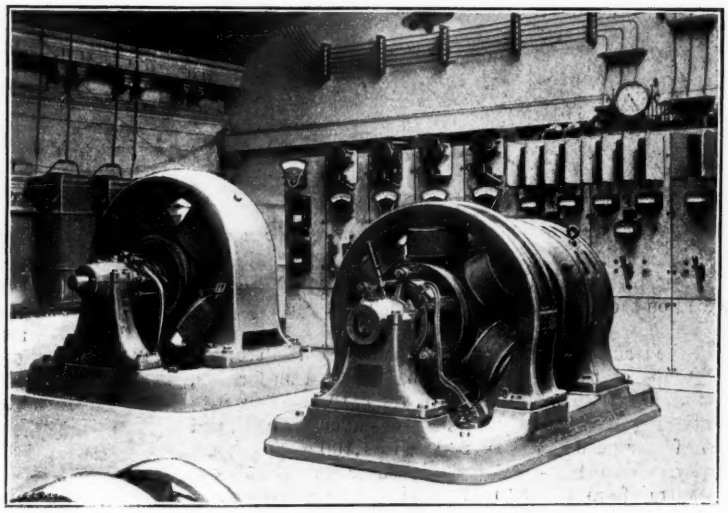
The increase in their suburban traffic has led the Orleans Railway Co. to investigate the means of improving the service and augmenting the speeds of their trains. The successful results attending the initial electrical installation have brought about an extension of the electric system, and at the present time, the portion of the trunk line from Austerlitz Station through the suburban district as far as Juvisy has been equipped with the third rail, and a frequent and fast service has been created. This service is handled by a number of motor-cars equipped with the Sprague Thomson-Houston train control system. The electric locomotives used for the original installation have been modified in their gear ratio in order to give a faster service, and three additional locomotives have been provided. The locomotives haul main line trains from the Quai d'Orsay terminus to Juvisy, a distance of 14 miles, where the engines are changed and the trains proceed on their way south. The same operation takes place with main line trains on their arriving at Juvisy destined for Paris. The locomotive trains will be operated on a fast schedule, a running time corresponding to over 40 miles per hour being adopted, covering the 12 miles between Juvisy and the old terminus of Austerlitz in about 17 minutes. The suburban trains, equipped with the train control system, make six intermediate stops between these points, and a schedule time of about 22 miles per hour is attained. The time taken to cover the 12 miles, exclusive of stops, is 25 minutes. The stops average about one minute each.



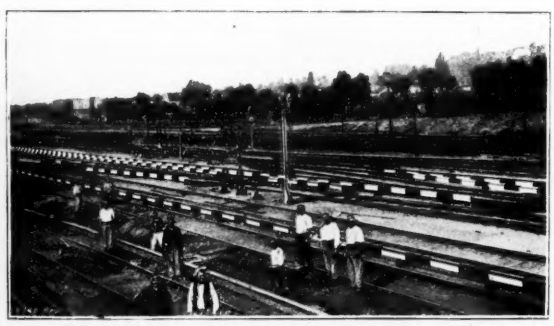
Sub-station in Ivry Power Station.

The main change in the original locomotives in order to adapt them to the new service was in the gear ratio. This, originally 4 to 1, has been changed to 2·23 to 1, giving a faster service. The new locomotives, although very different in appearance to those first put in service, contain practically the same equipment, with the exception that mica-insulated armature coils have been substituted for the cotton-insulated coils used on the eight original machines. An improvement has been made in the rheostat equipment, and reversing switches have been added.

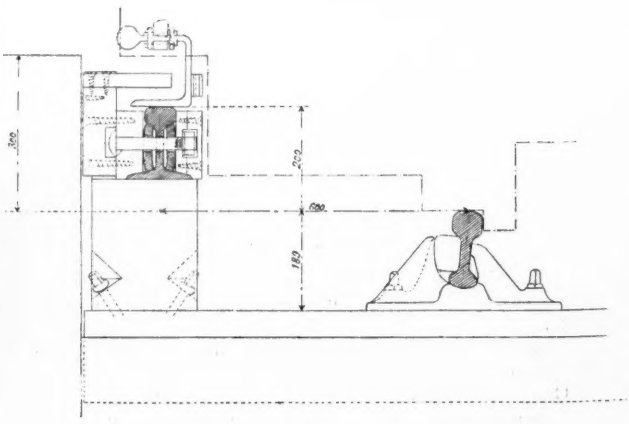
The new locomotives have been built to carry baggage in addition to the electrical equipment, which is contained in end cabins insulated with uralite sheeting. The disposition adopted necessitates the duplication of certain of the apparatus, notably the controllers, two being required instead of the single controller placed in the central cabin of the first locomotives. The additional advantage of baggage carrying capacity was, however, considered a sufficient advantage to offset such drawbacks. The locomotive body is 10·2 m. long, 2·84 m. wide, and 3·87 m. high; the distance between centres of bogie trucks is 5·63 m., and the diameter of wheels 4 ft. 1 in. The weight of the new locomotives, due



Interior of a Sub-station.



Third-rail Construction at Juvisy.



Arrangement of Third-rail on New Extension.

to the adoption of a steel armoured and insulated cab and to the increased dimensions of the locomotive body, is 55 tons.

There are two trains equipped with the train-control system of the well-known Sprague-Thomson-Houston type, each including eight trail-cars and two motor-cars, one at each end of the train. The motor-cars are equipped with four motors of the G.E.'66 type, as used in the Manhattan Overhead Railway. The motors are of 125 H.P. (at 215 amperes) based on a temperature rise of 75 deg. Centigrade over the surrounding air after one hour's run at full rated load, temperature of surrounding air not exceeding 25 deg. Centigrade. In this motor special attention has been given to ventilation, large holes with covers being provided at top, bottom, and sides of the frame. The latter is not split, but the armature can be taken out endways. Nose suspension is used. There are four field spools, wound with strip copper. The commutator contains 195 segments with mica insulation. The armature has a series drum barrel winding, with armature conductors made of copper bars specially constructed to prevent eddy currents. The conductors are separately insulated in sets of five with mica, which renders them semi-fireproof and able to withstand a high temperature without injury to the insulation. The weight of the motor is 4,300 lbs. The gear ratio is 3·08 : 1, the gear having 71 teeth. One-turn armatures are provided. The guaranteed efficiencies are 86 to 88 per cent. The motor-cars are mounted on bogie trucks of the Baldwin Locomotive Works type. The wheel base is 6 ft. 6 in., 40 in. wheels being used. They each weigh 6,250 lbs., and are calculated to carry a weight of 26,000 lbs., of which 15,000 lbs. is the weight of car (light) on centre pin.

The motor-cars are designed with a driver's cabin situated at each end. The remainder of the car is divided into two portions, one with seating capacity for 34 third-class passengers, and the other portion for the conveyance of baggage, &c. The end cabins are lined with uralite sheeting, and the whole of the car-frame is of uninflammable wood. All cabling is covered with asbestos braid, which has been painted lead colour. The shoe-leads are passed through flexible armour. The whole construction has been made as secure against fire as possible. All the train control apparatus, of the latest Sprague-Thomson-Houston type, as used on several London tube railways, is mounted in the cabins.

Similarly to the locomotives, the motor-cars are provided with side contact shoes, and also the overhead shoe to take current from the inverted "T" rail. The insulated contacts provided on the motor frames of the original locomotives have been omitted in the motor-cars and also in the new locomotives. The third rail contact, together with that afforded by the aerial rail, has proved sufficient for all needs.

Westinghouse air-brakes have been fitted to the two trains with motor-cars. The standard of the Orleans Co. has been the Wenger air-brake, which is too slow in action for the needs of the new service.

The dimensions of the motor-cars are:—Length over buffers, 17·3 m.; height, 3·8 m.; distance, centre to centre of bogie trucks, 12·4 m.; width, 2·8 m.

In addition to the above increase in rolling stock, the power station has been increased by the addition of one group of 1,000 KW. output, exactly similar to the two groups of this size already installed.

Among the changes in the power station occasioned by the extension is the removal of the entire switchboard from its old position, to install it on the opposite side of the power station. The switchboard has been increased by a number of panels bearing instruments of similar pattern to those already installed. A notable addition is a certain number of synchronism indicators, replacing the old synchronising voltmeters, plugs and lamps.

On the new switchboard, potential transformers are provided for an 11,000-volt circuit, and the oil switches, cut-out switches and other apparatus for the line panels are also arranged, where practicable, for the same voltage, which is to be ultimately used when the line is further extended. The present three-phase 25-cycle voltage is but 5,500, as already explained.

The usual indicating voltmeters, ammeters, wattmeters and power factor indicators are provided, together with their necessary transformers. The illustration on p. 907, shows the arrangement of the lighting and sub-station switchboards under the main switchboard gallery.

A new chimney stack, 50 m. in height, has been provided, and for the four new boilers are included two Green economisers, each of 224 tubes.

Two new sub-stations have been built—one in the power station itself, at Ivry, and the other at Ablon, close to the present station at Juvisy. The original sub-station at Austerlitz has been removed, and the traction and lighting machinery has been distributed as follows:—One of the two 250-KW. converters used for traction has been installed at Ablon sub-station. The remainder of the apparatus has been removed bodily to the new Ivry sub-station, and the battery has been increased to 290 cells.

Two new 500-KW. rotary converters have been installed in Ivry sub-station, together with transformers and reactances. The converters are six-pole, six-phase, 500 r.p.m., taking three-phase current at 440 volts, and giving a pressure of 625 volts D.C; they are compound wound, with the series winding reversed. They are designed to give a total output of from 400 to 500 amperes per machine, loads above this being divided between the machine and the battery. The transformers are of the air-blast type, six-phase 550 KW., stepping down the 5,500-volt three-phase current (25 cycles) to 440 volts. These transformers are also arranged to transform 11,000-volt, three-phase current to 440 volts, as the higher voltage will be used when the lines are prolonged as far as the more distant point of Bretigny, 13 km. beyond Juvisy, the present terminus.

The only change in the Orsay sub-station is the increase in the battery, from 260 to 290 elements, raising its output to 1,500 ampere-hours instead of 1,100 ampere-hours, and the pressure to 600 volts.

The new sub-station of Ablon is situated some 12 kilometres from the power-station, and 6 kilometres from the Juvisy terminus. In it are installed one 250-KW. converter, removed from Austerlitz sub-station, together with the set of three 100-KW. air-blast transformers, reactances and subsidiary apparatus. The new machinery includes two six-phase converters and necessary reactances, and two six-phase 550-KW. transformers, as at Ivry, the necessary rheostats and controlling apparatus, and a booster. For the lighting service has been installed a motor-generator set, similar to those already in service, but of smaller capacity. A new Tudor battery of 1,500 ampere-hours' capacity has been installed, consisting of 290 cells, each weighing about 530 kg., and containing 25 plates.

The voltage of the line will probably be regulated to about 600 volts on the third rail.

The switchboards in the sub-stations include the usual arrival panels for the high pressure line, machine and totalising panels, one each of the latter for the converters, measuring and registering instruments, and lighting panels.

The underground transmission cables are very similar to those installed for the first portion of the line in 1900. The extension includes some 25 kilometres of three-conductor paper-insulated lead-covered and steel-armoured cable. This cable is laid entirely underground, in duplicate, to avoid chances of breakdown. These two lines are usually operated in parallel. They are cut into three equal sections, and section boxes are provided at these points containing static dischargers, oil switches and meters. The section of each conductor is 80 sq. mm., against 50 to 75 sq. mm. in the original cables for the first portion of the line.

The cables are capable of carrying three-phase 25-cycle 11,000-volt current, to be used later. The tests made on the cables were at 30,000 volts, 50 cycles, between conductors and between conductors and ground during two hours, the voltage being raised then to 40,000 volts for two seconds. Further tests were also made after the cables were laid in the ducts.

It will be seen from the above that there is no fourth rail, and the track is used as a return circuit. The track has been bonded with about 25,000 bonds of a cross-section of about 112 sq. mm. The whole of the track is used as a return, and is bonded accordingly. At points and fixed crossings, where flexible bonds are unnecessary, copper ribbon bonds are used.

The third rail is bonded in two ways. One bond is used to connect the ends of the third rails, and the other bond connects the ends of the fish-plates, which run the whole length of the third rail. About 8,000 bonds have been used on the new third rail extension, which, as shown in the diagram on p. 910, differs somewhat from the original construction. The section of these bonds is about 220 sq. mm.

The third rail insulators are formed of impregnated and tarred blocks placed on the ends of the sleepers, spaced about every 20 metres, where a clear run is to be had. At crossings, and also in and around stations, the third rail is protected by vertical and horizontal wood sheathing painted white and red. The weight of third rail and continuous fish-plates is about 104 kg. per metre length.

The overhead inverted "T" rail is not used on the new extension, the third rail meeting all requirements.

The Orleans Railway Co. have built new stations all along the line and increased the tracks, making four in all running to Juvisy, the outside two being used for the electric traction.

A certain number of through or "rapide" trains run to Austerlitz without changing locomotives at Juvisy, the latter operation taking place at Austerlitz before the train leaves for Quai d'Orsay. The majority of the trains, however, have their locomotives replaced at Juvisy.

The new service to be handled is as follows:—The number of trains to be hauled from Austerlitz to Quai d'Orsay will be about 150 daily, thus continuing the old service. This number includes all main line trains, and a certain number of local trains. The time, as before, will be about 8 minutes, not including the intermediate stop. The two trains equipped with multiple unit control will make the shuttle service between Paris and Juvisy, and will be supplemented by a certain number of trains per day drawn by locomotives which also stop at all stations to Juvisy, but proceed further in charge of steam locomotives.

A number of express trains will make the journey Paris-Juvisy, and *vice versâ*, in 17 minutes, a change of locomotives being made at the latter station. The time taken by the all-station trains is about 25 minutes, exclusive of six stops of one minute each.

The number of locomotives on the service will be 10, of which one is reserved for station work. The eleventh locomotive is supposed to be under repairs or being cleaned. There are five motor-cars, one being held in reserve.

For the local traffic a half-hourly service is expected to be maintained, supplemented by a certain number of trains at business hours. The grades and curves on the extension are negligible.

The whole of the electric machinery has been furnished by the French Thomson-Houston Co., and the work has occupied about 15 months in all.

We wish to express our cordial thanks to the several administrative and executive officers of the Orleans Railway, by whose permission were obtained the foregoing illustrations and particulars.

TRAMWAY AND RAILWAY NOTES.

(*Continued from page* 906.)

Halifax.—Lieut.-Col. Druitt, in his report to the B. of T. on the collision which took place in Horton Street on October 14th, states that according to driver Rhodes's evidence, the electrical brake suddenly failed whilst he was descending Horton Street, and, being unacquainted with the use of the emergency electrical brake, he applied the hand-brake, but before he could stop the car, it had collided with another one. The cars are fitted with a mechanical slipper brake, and if Rhodes had been using this, there would have been no runaway. Col. Druitt adds that the electrical brake is useless should the trolley leave the overhead wire, or should the circuit of the trolley wire be interrupted. To meet this an emergency brake is provided, which can be instantly handled. Just at the time of the accident, a circuit-breaker controlling the feeder for the Horton Street section came out, and was apparently a contributing cause of the accident, since it interrupted the circuit of the trolley wire. Had Rhodes been familiar with and applied the emergency brake, the car could have been at once brought up. He tried to apply the hand-brake, but only got it on just as the collision occurred, since he only had a few seconds in which to act. Col. Druitt adds: "It will be seen that the main cause of the accident was the fact that Rhodes was imperfectly acquainted with the use of the special form of controller peculiar to these cars, and from his own statement had apparently little opportunity of learning. Had the circuit of the trolley wire not been interrupted, no accident would have happened, as the electrical brake is sufficiently powerful to bring the cars down the hill in question at a slow pace." In a report to the Tramways Committee on this matter, the manager, Mr. F. Spencer, refers to notices issued by him in August, informing all drivers that they must make themselves acquainted with the one-man cars as early as possible, and to the steps taken to give the men the necessary instruction. "It seems incredible to me," he adds, "that Rhodes could have driven these cars 184 miles, and not have understood what the word 'emergency' meant on the controller lid." The manager adds that before the cars are put into service again, he will lay before the Committee certain suggestions and improvements which will prevent the possibility of such an accident occurring again under the same conditions.—*Halifax Guardian.*

London.—Three L.C.C. electric car drivers were summoned at Lambeth Police Court on 28th ult., for driving their cars in Camberwell New Road at a speed exceeding 10 miles an hour, the maximum permitted by the Board of Trade regulations on that part of the system. On November 4th the Omnibus Owners' Federation employed two expert time-keepers to test the speed. Twelve cars were timed, and three of them exceeded the regulation speed—one, it was stated, travelling at the rate of 13·95 miles an hour, and the others at 13·04 and 12·25 miles an hour. The defence urged that the prosecution was undertaken, not for the protection of the public, but for the protection of other interests. A fine of 5s. and costs in each case was imposed.

The Stepney Borough Council has suggested something of a compromise between itself and the L.C.C. on the question of conduit *v.* trolley. It is suggested that the conduit system should be adopted for that portion of Mile End Road west of Burdett Road, and that, in the east portion of the thoroughfare, and in Burdett and Grove Roads, the overhead system should be used.

The Islington B.C. declines to consider anything in the nature of a compromise, and insists upon having the conduit system only.

It is stated that the London United Tramways Co. intends soon after Christmas to commence constructing the whole of the authorised lines, 15 miles in extent, in Kingston, Surbiton, the Dittons, Molesey, New Malden and Wimbledon. "The cost, irrespective of street widenings, will be about half a million sterling, and of this sum £250,000 will be spent in wages."

Paisley.—The District Tramway Co. has given notice that it intends to apply in the ensuing session of Parliament for a provisional order for further powers and extensions. The new lines proposed include an extension from Johnstone to Kilbarchan, and among other powers sought is the increase of the rate of speed and sanction to provide motor-cars or omnibuses.

South Australian Railways and Tramways.—An Australian correspondent has sent us a cutting from an Adelaide paper giving a reprint of the report of the consulting engineer, Mr. F. E. Bradford, B.Sc., on the South Australian Government's proposed railway electrification scheme. It deals, first, with the electrification of two short suburban railway services, each about 10 miles in length; secondly, with the electrification of about 70 miles of horse tramways at present worked by five separate private companies. The report was called for by the Government, who are trying to carry a Bill through the House for the compulsory purchase of all the present tramways, and to call for tenders both for the construction and equipment of the lines, and afterwards for the leasing of them for a number of years. The electrification of the railway system is not, it is believed, seriously contemplated at present, although the engineer's report is strongly in favour of a combination of the two schemes at once. The length of track proposed to be laid immediately, is about 45 miles in the more thickly inhabited portions of the City of Adelaide and suburbs, and a clause has been introduced in the Bill, making it compulsory for the contractor to extend the system to the present remaining 25 miles situated in the more sparsely populated districts within a period of about 10 years. "At the moment of writing," says our correspondent, "the Bill is being taken through its third reading, and it looks as if the Government's scheme, for the tramways at least, will pass through both Houses." In the report of the consulting engineer, considerable stress is laid upon the advantages of adopting the single-phase system for the scheme. The generating station is proposed to be placed at Port Adelaide on account of cheaper water and coal facilities, making the distance of H.T. transmission to the train centre 8½ miles.

Stirling.—A note of terms upon which the Tramways Co. is prepared to sell part of its system to the T.C. has been referred to the engineer to report upon.

West Ham.—At Tuesday's meeting of the Corporation, provisional arrangements made by the electrical engineer with Messrs. Ferranti, Ltd. (now in the hands of the Official Receiver), for the firm to continue to supply certain special parts peculiar to their engines and alternators were approved; 34 tramway trucks of either the McGuire or Brill type are to be obtained at a cost not exceeding £69 each. The tramway manager was instructed to endeavour to arrange for the equipment of one of the new cars with the Raworth system of regenerative control.

Jungner Battery 'Buses.—The Jungner Accumulator Co. has recently started a public service of electrical motor omnibuses in the town of Norrköping. Three vehicles are in use, having accommodation for 10 passengers and the driver. They are, of course, provided with a battery of Jungner accumulators, and are designed for a speed of 12 kilometres per hour.

TELEGRAPH AND TELEPHONE NOTES.

Continental Telephones.—According to the *Journal Télégraphique*, since November 15th last, telephonic communication between Switzerland and Luxembourg has been open *vid* Strassburg—Metz. The interested States have agreed that there shall not be more than five intermediate stations, the terminal offices included. The charge is 4 fr. for a conversation of three minutes.

Le Bund states that, for the purpose of establishing telephonic communication between Würtemberg, Bavaria and Switzerland, the Administrations of Posts and Telegraphs of the two former States have proposed to lay a telephonic cable across the lake of Constance, between Romanshorn and Friedrichshafen. The Swiss Administration has notified the German States that the necessary funds have been provided for in the Budget for next year to meet one-half of the cost of the undertaking. The class of cable to be laid has not yet been decided upon, but the outlay has been based on the cost of the telegraphic cable already laid across the lake. The Würtemberg Administration has undertaken the laying of the cable.

Hull Telephones.—The Hull Corporation Telephone Exchange was opened on 28th ult. The work of construction commenced in January last. The manager is Mr. T. Holmes. The work has necessitated 19 miles of trenching in the streets. The Central Exchange switchboard has accommodation for 2,000 subscribers, which can be extended to 5,000. The Mayor presented a gold key, suitably inscribed, to the chairman of the Committee, Councillor Brown. The switch-room door was then opened by the Mayoress, a gold key being given to her by Mr. Brown, and the apparatus was then explained by Mr. A. R. Bennett, the consulting engineer, and Mr. Holmes, the manager.

The National Telephone Co. are extending their underground cable system here. The work, when completed, will provide conduits into the exchange buildings capable of holding sufficient cables to supply 12,000 subscribers.

New Cable Steamer.—A new cable steamer entered the Tyne on 22nd ult. from the shipbuilding yard of Swan, Hunter, and Wigham-Richardson, Low Walker. The vessel, which is named the *Cambria*, will be owned by the Telegraph Construction and Maintenance Co., Ltd., for whom the builders recently constructed the *Colonia*, the largest cable ship afloat. The *North Mail* says that nearly 300 ft. in length × 37 ft. beam, the steamer will be propelled by twin-screw engines of the triple-expansion type, which are designed to drive the ship at a speed of 12 knots per hour. She will be completely equipped for her service with the latest machinery for picking up and paying out the cable, as well as with all the latest devices for working the ship and for the comfort of the crew, both in the tropics and in colder climates. The owners were represented at the launch by Mr. F. R. Lucas, and the christening ceremony was performed by Mrs. Lucas.

Paris—Rome Telephones.—Dalziel says that a new telephone line has been constructed between Paris and Rome. Tests of the wire have proved highly satisfactory.

Swiss Telegraphs and Telephones.—For the year 1903 the receipts on account of the Swiss telegraph and telephone service were 3,113,679 fr. and 6,592,009 fr. respectively, or a total income of 9,705,688 fr. Expenses were respectively 3,234,879 fr. and 7,651,201 fr., or a total of 10,886,081 fr., leaving a deficit of 121,200 fr. on account of telegraphs; and 1,059,192 fr. on account of telephones, or a total deficit of 1,180,392 fr. for the year.

Telephone Cable for the Simplon Tunnel.—The Swiss Confederation have provided for an outlay of 230,000 fr. in the Budget for 1905, according to *Le Bund*, to cover the cost of a telephonic cable in the Simplon Tunnel. The above sum is only approximate, as the details have not yet been decided. Owing to difficulties of a local and technical nature, the establishment of this line cannot be undertaken by the Administration, but will have to be left to the cable manufacturers.

Telephony during Thunderstorms.—The experiments made in the direction of maintaining an uninterrupted telephone service during the prevalence of thunderstorms in the Berlin telephone area are reported to have yielded favourable results. It was sought, first of all, to limit the service under such conditions to offices Nos. 1 and 3, which are connected by means of underground cables, but this was found impracticable, and it was therefore arranged that a continuous service should be undertaken at all the offices in Berlin. At the same time the Post Office authorities prescribed that connections should be suspended at those exchanges which still have overhead wires, in so far as the storms manifested themselves within the districts of those exchanges. In some cases it is considered that sufficient precautions were not taken in this respect in the past, as many telephone girls suffered as a result of electric discharges. Such accidents have, however, not occurred during the past summer, as the suspension of the service has been more rigorously carried into effect on the approach of a storm. This arrangement, which will also be enforced next summer, will be materially facilitated by the expectation that the transformation from overhead to underground lines will have been completed by that time in connection with offices Nos. 4, 6 and 7. It is said to be impossible to entirely change over from aerial to underground cables, owing to the refusal of property owners to allow the pipes to be laid through their gardens.

Testing of Telegraph Apparatus.—It appears that the Berlin State telegraph authorities, either at the central telegraph office or at the telegraph engineering bureau in the Oranienburger Strasse, are making exhaustive tests of modern telegraph apparatus. The latter include those devised by M. Baudot, Prof. Henry A. Rowland and Mr. Donald Murray. The Baudot apparatus is being tested between Berlin and Paris, and the Murray apparatus between Berlin and Emden. So far, however, the Hughes apparatus has proved to be the most applicable, and is the type which is said to be mostly used in Germany.

Wireless Telegraphy.—It is reported in the daily papers that a telegram by wireless telegraphy has been transmitted by Mr. Marconi from the Marconi Co.'s station at Poldhu, Cornwall, to a station belonging to the Italian Government at Ancona, Italy. The message was addressed to the Admiral Mirabello, Italian Minister of Marine. Admiral Maribello replied, thanking Mr. Marconi for his wireless message, which he said had been duly received at the Ancona station. The station at Ancona is a small station, not originally intended for long-distance work. The distance between Poldhu and Ancona, about 1,000 miles, is almost entirely overland, and in order to reach their destination the signals had to pass over nearly the whole of France and a considerable part of Italy, including some of the highest mountains of the Alps.

The Jeddah-Suakin Cable.—A Press report says that a recent meeting of the Special Commission on the unsatisfactory state of the cable from Jeddah to Suakin discussed the chronic untrustworthiness of the line and the repeated breakdowns, and decided, in principle, on the adoption of wireless telegraphy.

CONTRACTS OPEN AND CLOSED.

OPEN.

Belgium.—December 14th. The Belgian State Railway Authorities at La Bourse, Brussels, are inviting tenders until the 14th inst. for the supply of 239,000 metres of arc lamp carbons.

Cardiff.—December 19th. Two slow-speed vertical engines, and 1,100-kw. three-phase alternators; four Lancashire boilers, piping, switchboard gallery, three-phase cables, &c., for the Corporation. See "Official Notices" to-day.

Dublin. — December 5th. The D.U.T. Co. wants tenders for a year's stores. See "Official Notices" November 18th.

Edinburgh.—December 14th. Electric lighting installation for the Branch Free Library. See "Official Notices" November 25th.

Egypt.—Electric lighting materials required for Municipality of Suez. See Egyptian *Journal Officiel*, November 5th, at Commercial Intelligence Branch, B. of T.

Glasgow.—December 5th. The Corporation are prepared to receive tenders for the electric light installation, &c., for Dennistoun District Library. Specifications and forms of tender from Mr. James R. Rhind, 67, Hope Street, Glasgow; and sealed tenders marked "Dennistoun Library—Tender for Electric Light Installation," must be lodged with the subscriber not later than 10 a.m. on Monday, December 5th.

Glasgow.—December 22nd. The Corporation is inviting tenders for the supply of 100 electric car motor equipments and spare parts for same. Specification on application to Mr. James Dalrymple, general manager, 102, Renfield Street, Glasgow.

Johannesburg.—December 27th. Transformer pillars and switchgear; also two 35-ton electric overhead travelling cranes, for the Municipal Council's electrical undertaking. See two "Official Notices" October 28th.

Kilmarnock.—December 6th. Advertising on tramcars. See "Official Notices" November 25th.

Kirkcaldy.—December 7th. One 10,000 gal. cast-iron water storage tank at the generating station, Victoria Road, including excavations, cast-iron suction pipes, &c. Specification on application to the Burgh Electrical Engineer.

Llandilo.—December 6th. Testing and calibrating the electricity meters installed in the town (70) for the U.D.C.

London.—December 10th. Tender for 12-ton, 40-ft. span electric travelling crane, with drawings and specification to B. E. Nightingale, Albert Works, Albert Embankment, S.E.

Manchester Ship Canal.—December 22nd. Switchboards, mains, feeders, arc lamps, &c., for the new dock works at Salford. See "Official Notices" to-day.

Middlesbrough.—December 17th. Pipe-work and valves for the Electricity Committee. See "Official Notices" to-day.

Roumania.—January 28th, 1905. Tenders are being invited by the municipal authorities of Guirgin for the concession for the electric lighting of the town.

Salford. — December 3rd. One feeder booster. See "Official Notices" November 18th.

Shanghai. — March 31st, 1905. Construction and working of 24 miles of electric tramways on the trolley system, double or single. See "Official Notices" October 14th.

Southend-on-Sea.—December 21st. Two boilers, steam dynamo, fuel economiser, and two electrical feed-pumps, for the Corporation. See "Official Notices" to-day.

Spain.—December 12th. The Municipal Authorities of Salamanca are inviting tenders until December 12th for the concession for the electric lighting of the town during a period of 10 years. Particulars may be obtained from El Secretario del Ayuntamiento de Salamanca, to whom tenders are to be sent.

Spain.—December 12th. The Spanish Post and Telegraph Authorities in Madrid are inviting tenders until December 12th for the establishment and working of a telephone exchange in the town of Talavera de la Reina (Toledo province). Particulars may be obtained from, and tenders are to be sent to, La Direccion General de Correos y Telegrafos, Carretas, 10, Madrid.

Trimdon Grange (Durham).—December 5th. The owners of East Hetton, Trimdon and Trimdon Grange Collieries invite tenders for 12 months' supply of stores, including electric light fittings. Forms of tender from Storekeeper, Trimdon Grange Colliery, co. Durham. Tenders to Messrs. Walter Scott, Ltd., Trimdon Grange Colliery.

Swindon.—December 20th. One 300-KW. or 400-KW. steam dynamo, for the Corporation. See "Official Notices" to-day.

West Ham.—Fan engine and "Sirocco" fan, steel chimney, condenser, tanks, hot well, and piping for the electricity department. See "Official Notices" to-day.

CLOSED.

Belfast.—The Tramways Committee recommends the following tenders for acceptance:—

Contract No. 1.—Permanent way, road bed paving and bonding. Messrs. J. G. White & Co., Ltd., London, £280,644.

Contract No. 2.—Overhead electrical equipment. Messrs. J. G. White & Co., Ltd., £88,810.

Contract No. 3.—Underground feeders, telephone and test wires and spare conduits. Messrs. J. G. White & Co., Ltd., £65,264.

In consideration of getting these three contracts, this firm agree to deduct £1,000 from their total charge; in other words, to reduce the gross sum from £384,717 to £383,717.

Contract No. 4 (steam dynamos, switchboard, three-phase plant, condensing plant, overhead traveller and station lighting). British Westinghouse Co., £40,933.

Contract No. 5 (boilers, superheaters, mechanical stokers, economisers, coal and ash conveying plant, steam exhaust and feed pipes, and pumps), Messrs. Fairbain, Lawson, Combe Barbour, Ltd., £19,740.

The acceptance of this last tender is recommended subject to the special condition that any work done in the firm's own foundries under this contract, shall be done in Belfast.

Contract No. 6, (double-deck electric tramcars), Brush Electrical Engineering Co., £93,624.

These six contracts, allowing for the reduction of £1,000 on the first three, amount to a gross total of £538,014.

The above recommendations were to come before this week's meeting of the Council.

Birmingham.—An order has been placed with the Brush Electrical Engineering Co., Ltd., by Raworth's Traction Patents Syndicate, for 80 regenerative tramway motors for the Birmingham and Midland Tramways.

Dewsbury. — The tender of the British Thomson-Houston Co. has been accepted by the Electricity Committee for a motor air-compressor for the electricity works.

France.—The French Post and Telegraph Authorities in Paris have just placed a contract with La Société Industrielle des Telephones for 240 kilometres of telephone cable.

Hammersmith.—The B.C. has received the following tenders for cables:—

Western Electric Co. (accepted)	£2,226
Henley's Telegraph Works Co., Ltd.	2,313
Callender's Cable Construction Co., Ltd.	2,340
Imperial Engineering Supplies Co., Ltd.	2,429
Siemens Bros. & Co., Ltd.	2,443
The Electrical Co., Ltd.	2,386
W. F. Dennis & Co.	2,648
St. Helens Cable Co., Ltd.	2,973
Lucy & Co., Ltd.	3,203

The same Council has placed the following orders:—Eight 100-KW. transformers, the British Electric Transformer Manufacturing Co., Ltd., £120 each; the patent high-tension discriminating switchgear for Olympia, Messrs. Cowans, Ltd., Salford, £229 10s.

Manchester.—One half share of starting switches required by the Corporation for the ensuing 12 months has been ordered from Veritys, Ltd., who will supply their improved "Aston" type.

Napsbury.—The tender of the Hart Accumulator Co., Ltd., for a storage battery of 115 1,050-ampere-hour standard lighting type cells for Napsbury Asylum has been accepted by the Middlesex County Council. The Council has also accepted the tender of the Western Electric Co. for the supply of electric mains at £885. The contract price for the battery and booster is £1,027, and for maintaining the battery for 10 years, £70 per annum.

North Shields.—The Borough of Tynemouth has arranged with Messrs. Veritys, Ltd., for the hire-purchase of motors and starting switches.

Oldham.—The Corporation has arranged with Messrs. Veritys, Ltd., for the hire-purchase of motors, starters and radiators.

Portsmouth.—The Corporation Telephone Committee has accepted the tender of Mr. R. W. Paul, of London, for the supply of test instruments, at £32 17s. 6d., and that of the National Electric Co. for 100 wall instruments, at £2 5s. 9d. each.

Preston.—The T.C. has accepted the tender of Messrs. Dick, Kerr & Co., Ltd., for alterations to 11 tramcars, at £17 17s. each.

West Ham.—The County Borough Council has placed the following orders in connection with electric tramway construction:—

Three cross-over roads, Messrs. Edgar Allen & Co.

Ten sets temporary cross-over roads and turn-outs, Messrs. W. Griffiths and Co., Ltd.

Jarrah wood paving blocks, Messrs. W. Griffiths & Co., Ltd.

Portland cement, Messrs. Martin Earle & Co., Ltd.

Drain boxes, The Railway General Engineering Co., Ltd., Nottingham.

Cartage of material, granite, rails, excavation, &c., and supply of sand and ballast, Mr. W. G. Harris, Stratford, and Mr. S. Wakeland, Canning Town.

Eight sets Turner's automatic point adjusters, S. Dixon & Son, Ltd., £93 each.

The following tenders were received by the same Council for 35 tramcars:—

Brush Electrical Engineering Co., Ltd.	£528 10 0 each.
Witting, Eborall & Co., Ltd.	542 15 0 "
" " " (alternative)	555 17 0 "
Hurst, Nelson & Co., Ltd.	547 0 0 "
British Westinghouse Co., Ltd., Manchester	552 15 0 "
British Thomson-Houston Co., Ltd.	575 15 0 "
Dick, Kerr & Co., Ltd.	582 0 0 "

The tender of the Brush Electrical Engineering Co., for car bodies at £280 each, and one radial truck, at £96 10s., was accepted, as was also that of Messrs. Dick, Kerr & Co., for electrical equipments, at £200 each.

FORTHCOMING EVENTS.

Friday, December 2nd.—At 8 p.m. Junior Institution of Engineers. Mr. H. E. Yarrow on "Some Points of Interest in the Construction of Torpedo Boats."

Saturday, December 3rd.—Institution of Electrical Engineers (Manchester Students). Visit to the Corporation sub-stations.

Monday, December 5th.—Society of Engineers (Royal United Service Institution), paper by Mr. W. E. Storey, on "Condensing Machinery."

Tuesday, December 6th.—At 8 p.m. Institution of Civil Engineers. Continuation of discussion on Mr. J. F. C. Snell's paper on "Distribution of Electrical Energy."

Wednesday, December 7th.—At 7.30 p.m. Institution of Electrical Engineers (Students). Mr. M. G. Tweedie on "The Gordon Electric Light Installation at Paddington, 1884—1904."

At 8 p.m. Society of Arts. Mr. W. Francis Reid on "The International Exhibition at St. Louis."

Institution of Civil Engineers (Students). Visit to the Motor-Car Works of Messrs. D. Napier & Son.

Thursday, December 8th.—At 2 p.m. Institution of Electrical Engineers (Students). Visit to the Robertson Electric Lamp Works, Brook Green, Hammersmith, W.

At 8 p.m. Institution of Electrical Engineers. Prof. H. S. Hele-Shaw, Dr. Alf. Hay, and Mr. P. H. Powell on "Hydro-dynamical and Electro-magnetic Investigations regarding the Magnetic Distribution in Toothed Core Armatures." (Conclusion of discussion.)

Friday, December 9th.—At 8 p.m. Physical Society. Prof. S. P. Thompson "On a Rapid Method of Approximate Harmonic Analysis." Mr. W. Duddell on "A High Frequency Alternator." "Exhibition of Experiments to show the Retardation of the Signalling Current on 3,500 miles of the Pacific cable between Vancouver and Fanning Island." "Exhibit of Ayrton-Mather Galvanometers, Universal Shunts, and Electrostatic Instruments."

At 8 p.m. Electro-Harmonic Society. Smoking concert.

Saturday, December 10th.—At 3 p.m. Junior Institution of Engineers will visit the International Gas Exhibition at Earl's Court.

At 7.30 p.m. Annual Mess Dinner of the Electrical Engineers R.E. Volunteers at Anderton's Hotel, Fleet Street, E.C.

THE ELECTRICAL VOLUNTEERS.

The following are the orders for next week:—

Monday, December 5th.—"A" Company: Recruits' drill, 6 p.m. Technical instruction, 7 p.m.

Tuesday, December 6th.—"B" Company: Recruits' drill, 6 p.m. Technical instruction, 7 p.m. Medical inspection for recruits and Special Service Section, 7 p.m.

Wednesday, December 7th.—Instructional drill, Westminster Hall, 8 p.m. Plain cloths; rifles without slings. Submarine mining class 6—9 p.m.

Thursday, December 8th.—"C" Company: Recruits' drill, 6 p.m.; technical instruction, 7 p.m.

Friday, December 9th.—"D" Company: Recruits' drill, 6 p.m.; technical instruction, 7 p.m.

Saturday, December 10th.—Week-end class.

NOTES.

Nernst Lamp Infringement.—The Berlin Allgemeine Electricity Co. announces having taken legal proceedings against an international company for selling imitations of the Nernst lamp, which constitute an infringement of the patents relating to the latter lamp. As a result, the first Land Gericht of Berlin has issued a provisional injunction prohibiting the further manufacture and sale of the offending lamp, and third parties are forbidden to make use of it in the future. The penalty for each contravention of the order of the Court has been fixed at £75.

South African Notes (from our Durban correspondent). —*Pietermaritzburg* (*Natal*) *Electric Tramways.*—The inauguration of the Pietermaritzburg electric tramways took place on November 2nd, and was attended with great success. The proposal to have electric tramways was first laid before the Council in 1898, but it was not until September 23rd last year that a start was made in laying the rails. The undertaking has been a very costly one for its size, involving an expenditure of £105,000, thus exceeding the original estimate by £30,000. The system as at present opened is from the power station through Railway and Church Streets as far as Retief Street, and along Commercial Road from Loop Street to Victoria Bridge. The route to Scottsville is laid, but running cannot take place until the bridge over the Fox Hill Spruit has been completed, which is estimated to take another two months. With the Botanic Gardens section, work is well advanced, and it is hoped to have that section opened early in the coming year. The ceremony of switching on the current was performed at the power station by Miss Cosy Scott, the little daughter of Councillor C. W. B. Scott, chairman of the Tramway Committee; and after an inspection of the machinery, the guests proceeded to the car-sheds, the cars being well decorated for the event. The Mayoress drove the first car, and, after a tour of the route, the guests partook of luncheon at the Town Hall, the Mayor presiding. After the loyal toast had been honoured, the Mayor called upon Mr. Scott, who proposed "Success to the Tramways," coupling with the toast the name of Mr. P. Finlayson, the tramway manager. Mr. Finlayson, in replying, was proud of the fact that Pietermaritzburg was the first inland town in South Africa to adopt electric tramways, and he hoped the other towns which were anxiously waiting to see the results would be encouraged thereby. Touching on the probable success of the tramways, he mentioned that by popularising the Botanic Gardens and the Victoria Park, they would enormously increase their tramway receipts, and instanced the effect at Cardiff, where the Corporation tried a band in Roath Park, and found it increased their receipts by 50 per cent. His proposal to lay a branch line from Victoria Bridge right into the park will, he hopes, soon be put in hand. The proceedings terminated by the Premier of the Colony, Sir George Sutton, proposing the health of the Mayor, who suitably responded.

We regret to learn that Mr. S. Ashby, the borough electrical engineer of Pietermaritzburg, finds himself compelled to retire on account of failing sight.

Harrismith (*O.R.C.*).—The electric lighting system, which has been installed at a cost of £16,000, was formally opened on October 26th, when the Mayoress, Mrs. Caskie, switched on the current. Speeches were made congratulating the municipality on the soundness of the scheme. The light has been freely taken up by storekeepers and residents, and it is hoped that the military authorities will be induced to take current for the lighting of the cantonments at King's Hill.

Kimberley (*Cape Colony*).—The township of Beaconsfield was lighted by electricity on October 30th, the power being supplied by the De Beers Co.

The Electro-Harmonic Society.—The next Smoking Concert is to be held at the Holborn Restaurant, in the usual place (King's Hall), on Friday, December 9th, when Mr. F. H. Nalder will preside. Vocal music will be rendered by Messrs. Harold Wilde and Robert Radford; bassoon solos by Mr. E. F. James; violoncello solos by Mr. W. B. Walter O'Donnell. There will also be a 'cello and pianoforte duet by Mr. O'Donnell and Mr. Izard. Humorous sketches will be given by Harry Scarsdale, humorous recitations by Mr. Charles Wreford, and musical sketches by Mr. Nelson Jackson.

Lord Ampthill and Kashmir Water-Power.—It is reported that Lord Ampthill, the Acting Viceroy, when leaving Kashmir the other day, said that Kashmir State was in a most prosperous condition. He hoped for railway communication with India at an early date, and the utilisation of the enormous water-power of Kashmir for electrical purposes.

I.E.E.—The members of the Birmingham Local Section of the Institution of Electrical Engineers met on 23rd ult. at the University, when the chairman, Dr. W. E. Sumpner, delivered his inaugural address, the subject being "The Use of Iron in Alternate Current Instruments."

Appointments Vacant.—Temporary draughtsman for Swindon Corporation (30s.); working electrical foreman for Manchester Education Committee (45s.); electrical engineer and tramways manager (£400), also traffic manager (£200), for Walthamstow.

The London Chamber of Commerce (Electrical Section).—A meeting of this Section was held last week, Mr. C. P. Sparks presiding, to consider the draft regulations relating to the use of electricity in factories, and a large number of communications from members of the Section on the subject. It was decided that objections should be sent in to the Home Office with the object of securing a *locus standi* at the inquiry, which will be held in due course in accordance with the provisions of the Factory and Workshop Act, 1901. The Section has pointed out generally the difficulties and inconveniences which may arise from the existence of two sets of regulations administered in the same factory by two different Government departments, and submits that the Home Office regulations should be on identical lines with the proposed amended Board of Trade regulations under the Electric Lighting Acts, 1882 and 1888; also that the testing departments of electrical manufactories should be exempted from the operation of the regulations, as electrical manufacturers are manifestly unable to comply with the regulations in view of the special circumstances of the case. Coming to particular clauses, the Section has made the following suggestions:—

Clause 1.—That alternative systems should be allowed in view of the advantages in certain cases of employing cables run on insulators, and the adoption of other approved methods.

Clause 5.—That main distributing boards which are in charge of a special attendant should be exempted from the regulations with regard to the enclosing of switches.

The Section submits that the requirement as to the earthing of lampholders would be troublesome, and suggests as an alternative that an approved type of lampholder should be permitted.

Clause 6.—That as electrical "undertakers" are already under penalties prescribed in various Sections of the Board of Trade regulations, to see that their work on consumers' premises is efficiently carried out, the Section submits that it is unfair to put the onus of giving annual certificates, as proposed, on such undertakers.

It was reported that the Home Office had acknowledged the representations of the Section with reference to Electricity in Mines.

London County Council.—At the meeting on Tuesday, the Finance Committee reported that the Woolwich Borough Council had applied for an advance of £1,000 for the assisted wiring of consumers' premises for electric lighting, and the letting on hire of electric motors and other appliances. It appeared that the Borough Council under its Act of 1903 obtained special powers for this purpose. On the recommendation of the Committee the Council resolved to lend the money, which would be repayable within eight years.

The Highways Committee stated that of the four 5,000-H.P. engines ordered from Messrs. John Musgrave & Sons for the Greenwich power station a year ago, one had been completed at the company's works and was being dismantled preparatory to the erection of the second engine. As, however, it was not yet possible for the Council to arrange for the reception of the first engine owing to the power station not being in a sufficiently advanced stage, the contractors had asked for some payment to be made on account of the work completed. The Committee expressed the opinion that the request might be reasonably complied with, and they therefore obtained authority for advances to be made to the company.

The question of providing seats for drivers and conductors, which was recently brought forward, was again referred to by the Highways Committee. The Committee reported having reviewed the circumstances once more and it was convinced of the inexpediency of arranging for seats, as had been suggested or petitioned for by the Society of Tramway Workers, certain of the Council's drivers and conductors, and by members of the medical profession.

Municipal Electrical Association.—The members of the Council of the Municipal Electrical Association met in Harrogate on November 25th. The members attending included Mr. T. P. Wilmshurst, Derby (President); Mr. F. A. Newington, Edinburgh (President-elect); Mr. J. H. Rider, electrical engineer to the L.C.C.; Mr. R. A. Chattock, Birmingham; Mr. J. F. C. Snell, Sunderland; Mr. C. D. Taite, Salford; Mr. S. E. Fedden, Sheffield; Mr. H. Talbot, Nottingham; Mr. J. Christie, Brighton; Mr. H. Kilgour, Cheltenham; and Mr. J. P. Smith, Barrow-in-Furness.

Bequests to Education.—The *Times* announces that Mr. Frank McClean, F.R.S., F.R.A.S., M.I.C.E., the well-known engineer and astronomer, who died on November 9th, aged 66 years, bequeathed £5,000 to the University of Cambridge, to be expended in improving the instrumental equipment of the Newall Observatory, £5,000 to the University of Birmingham (in addition to his previous subscription) to be applied in the department of physical science, £2,000 to the Royal Society of London, £2,000 to the Royal Institution of Great Britain, £2,000 to the Royal Astronomical Society of London, and gifts of books, MSS. and objects of art to the University of Cambridge for presentation to the Fitzwilliam Museum.

Papers, &c.—At a meeting of the Royal Scottish Society of Arts, held in Edinburgh on Monday, a communication was read by Mr. Alexander Clark, A.M.Inst.C.E., on "The Tram and Road-Car of the Future."

At the Midland Institute, Birmingham, on 23rd ult., before the members of the Scientific Society, Mr. B. Davies dealt with "Magnetic Space Telegraphy."

American Mechanical Engineers.—Next week from December 6th to 9th the American Society of Mechanical Engineers holds its fiftieth meeting at New York. We have received a copy of the programme, which includes a number of papers on such subjects as condensers for steam turbines, values of water power, centrifugal fans, steam meters, water-tube boilers, fuel consumption of locomotives, and so on.

The Victoria Falls.—The directors of the African Concessions Syndicate, Ltd., have decided to postpone the dispatching of the expedition to the Victoria Falls during the next dry season, and have obtained the consent of the British South Africa Co. for an extension by one year to the dry season of 1905, for the purpose of making the necessary preliminary surveys under the terms of the concession.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the power station or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*]

Central Station Engineers.—Mr. H. A. Fleet has been appointed station superintendent to the Yorkshire Electric Power Co., and has resigned the corresponding position held by him at the power station of the Mersey Railway Co.

Mr. J. Enright, electrical engineer to the Islington Guardians, has been appointed consulting engineer to the same board.

The Athletic Club of the City of Leeds electric lighting department held their Annual Social and Prize Distribution on the 19th ult. Mr. H. Dickinson, the manager, presided, and in an interesting speech emphasised the need of physical culture. Mr. Ainscough moved, and Mr. Hefford seconded, a vote of thanks to the chairman. The rest of the evening was spent in dancing.

On Thursday last week, a presentation was made to Mr. J. Colbran, assistant in the Barnsley Corporation electricity works, on the occasion of his marriage. In the absence of Mr. E. A. Barker (borough electrical engineer), Mr. T. R. Stancombe (chief assistant) made the presentation.

General.—Mr. O. L. Remington, who has been on a visit to the States on behalf of his firm, Wm. McLean & Co., electrical engineers and contractors, of Melbourne, Australia, is expected to arrive in London somewhere about this date, and will be staying at the Hotel Cecil for about 10 days to a fortnight. As general manager of the firm mentioned, he is to negotiate for the representation for Australia, of new lines of electrical goods and appliances, and manufacturers of such are invited to communicate with him.

We are informed that Mr. Musgrave Heaphy has retired from the position of electrical engineer and scientific adviser to the Phœnix Assurance Co., and is succeeded by Mr. S. G. C. Russell, who for some time past has acted as electrical engineer to the company. The directors in expressing their great appreciation of Mr. Heaphy's past services, have recognised them in the most liberal and substantial manner on his retirement, and bearing in mind his unique experience, have retained his services as consulting electrical engineer. Few men are better known in the electrical and insurance profession than Mr. Musgrave Heaphy, the compiler of the well-known Phœnix Fire Office Rules. These rules in the early days of electric lighting, were the only recognised ones in existence, and whatever criticisms may have been levelled at them from time to time, there is no doubt that they did much to raise the standard of electrical installation work in many parts of the United Kingdom. Mr. Heaphy had, in the course of his lengthy experience, to very thoroughly investigate the electrical fire risk question in relation to electrical factories and central stations, and his views were not always acceptable to those most affected by his estimates, but we are sure that it will be the wish of everyone, who has had experience of his high and upright character, that he will live many years in enjoyment of his well-earned rest.

The Right Hon. Lord Kelvin was on Tuesday afternoon, in presence of a large and distinguished company, installed Lord Chancellor of the Glasgow University. The ceremony took place in the Bute Hall of the college buildings at Gilmorehill. Among those present were James Thomson Bottomley, M.A., F.R.S., D.Sc.; Guglielmo Marconi, and the Hon. Charles A. Parsons, M.A., D.Sc., F.R.S., upon all of whom the Lord Chancellor conferred the honorary degree of Doctor of Laws. Dr. Bottomley was presented as one who had for 24 years been Arnott and Thomson Demonstrator in the University, and had been for that period closely connected with the Chancellor. Of M. Marconi it was stated that his name and fame were abroad among the nations of the earth, because of his discoveries relating to the transmission of electric message signals over long distances without connecting wires. The Hon. Charles Parsons was presented as the inventor and perfector of the steam turbine. At the close of these ceremonies, Lord Kelvin delivered his inaugural address as Lord Chancellor. The speech was biographical. He said he was a child of the University of Glasgow, having lived in it 67 years (1832 to 1899); but his veneration for the ancient Scottish university—then practically the university for Ulster—began earlier than that happy period of his life. He proceeded to give an account of his father's connection with the old college, and his journeys from the north of Ireland to Glasgow. Dealing with his own early student life at the university, Lord Kelvin recalled that as far back as 1818 to 1830, Thomas Thomson, the first Professor of Chemistry in the University of Glasgow, began the systematic teaching of practical chemistry, and by the aid of the Faculty of Glasgow College, which gave the site and the money for the building, realised a well-equipped laboratory, which preceded, he believed, by some years Liebig's famous laboratory at Gissen, and was, he believed, the first of all the laboratories in the world for chemical research and the practical instruction of university students in chemistry. The university of Adam Smith, James Watt, Thomas Reid, was never stagnant. Nearly two centuries ago it had a laboratory of human anatomy. Seventy-five years ago it had the first chemical students' laboratory. Sixty-five years ago it had the first Professorship of Engineering of the British Empire. Fifty years ago it had the first physical students' laboratory—a deserted wine cellar of an old professorial house—enlarged a few years later by the annexation of a deserted examination room. In conclusion, the Chancellor congratulated the city on having for her god-daughter a university so splendidly equipped and so admirably provided with workers.

Obituary.—The *South American Journal* announces the death, following an operation, of Mr. E. M. Reiss, secretary of the United River Plate Telephone Co.

The *Bristol Times* announces the death of Mr. A. M. Hazel, the local manager of the Commercial Cable Co., and until recently sub-postmaster of Lawrence Hill. He resigned his position as telegraphist in the Postal Telegraph Service at Bristol, 25 years ago, for appointment with the French Cable Co., at St. Pierre, Miquelon. Eventually, owing to the Anglophobia which prevailed in the island, he was compelled to relinquish his position soon after the commencement of the South African War. He was one of the "Old Brigade" of telegraphists, known as pre-transfer men, who worked the telegraph systems when they were controlled by private companies, 40 years ago.

NEW COMPANIES REGISTERED.

Delafon Batteries Syndicate, Ltd. (82,567).—This company was registered on November 14th, with a capital of £1,000 in £1 shares, to acquire certain patents and inventions relating to improvements in electric and galvanic batteries, to adopt an agreement between P. Delafon, of the one part, and C. B. Hahn (for this company) of the other part, and to carry on the business of makers of batteries and primary and secondary cells, suppliers of electric light, electrical engineers, manufacturers of cables, wires, lines, accumulators, lamps and electric accessories, &c. The first subscribers (each with one share) are:—W. H. Collier, 47, Atlantic Chambers, Manchester, valuer; C. B. Hahn, 102, Bloom Street, Manchester, merchant; P. Hahlo, 46, Bloom Street, Manchester, merchant; B. Hahlo, 46, Bloom Street, Manchester, merchant; J. S. Sykes, 52, Princess Street, Manchester, merchant; S. Chatwood, 57, Mossley Street, Manchester, engineer; and D. R. Macfadyen, 102, Bloom Street, Manchester, buyer. No initial public issue. The number of directors is not to be less than two nor more than seven; the subscribers are to appoint the first; qualification, £50; remuneration as fixed by the company. Registered office, 102, Bloom Street, Manchester.

Mills, English & Co., Ltd. (82,558).—This company was registered on November 12th, with a capital of £30,000 in £10 shares, to acquire the business of mechanical and electrical engineers, india-rubber merchants, general mill furnishers, &c., carried on by C. H. Mills and W. E. English, at 35-6, Wind Street, Swansea, and at Castle Buildings, Llanelly, as "Mills, English & Co.," and the business of ironmongers, iron and steel merchants and mill furnishers carried on by Maria Paton and W. D. Jones, at 4, Castle Square, Swansea, and 1, Bridge Street, St. Thomas, Swansea, as "A. Paton & Co." The first subscribers are:—C. H. Mills, 71, Mansel Terrace, Swansea, engineering contractor, 1,000 shares; W. E. English, 8, Richmond Terrace, Swansea, engineering contractor, 1,000 shares; G. G. Grant, 5, Brooklands Terrace, Swansea, accountant, 1 share; Mrs. A. S. English, 8, Richmond Road, Swansea, 50 shares; Mrs. E. Mills, 71, Mansel Terrace, Swansea, 50 shares; R. B. Phillips, College Square, Llanelly, traveller, 80 shares; and T. J. Gwynne, 27, Brunswick Street, Swansea, clerk, 1 share. No initial public issue. The number of directors is not to be less than three nor more than five. The first are C. H. Mills, W. E. English and R. B. Phillips; qualification, £300; remuneration as fixed by the company. Registered office, 4, Castle Square, Swansea.

CITY NOTES.

British Westinghouse Electric and Manufacturing Co., Ltd.

In the speech which the chairman (Mr. George Westinghouse) made to the shareholders on February 5th last (Electrical Review, February 12th, 1904, page 271), he explained the causes for the delay in getting the works into operation, and remarked that it was not expected their production would reach a normal condition, even this year. To the question whether their works had, in view of general existing conditions, been planned upon too large a scale, he, unhesitatingly, said "No," and he based this opinion on the development of the electrical business in the United States.

The report of the directors for the year ending July 31st last, is now before us. They report a profit of £50,550 2s. 4d., which, after providing for interest on loans and debentures, permits the carrying forward of £2,809 15s. 11d. For depreciation, £10,500

has been written off for plant, nothing off buildings or patents. 100,000 preference shares have been issued to the American Co., thus increasing the capital by £500,000. Since the expiry of the year to which the accounts refer, £400,000 debenture stock has been issued to the American Co., the temporary loans have been repaid, and sundry creditors' amounts considerably reduced. It is at length recognised that the "general expense and outlay" on the Trafford Park plant "has been much greater than the management anticipated," but the expenses have been incurred, and have placed the "factory in an advantageous position to execute orders in the future for large generating units." Improvements have been introduced materially curtailing manufacturing costs, and diminishing selling and administration expenses. A larger amount of work is being turned out for a smaller amount of labour, the contracts completed at the works are increasing, and the margin of profit is moving upwards. While it is not possible to declare a dividend on the preference shares, the outlook for the current year is encouraging. The orders obtained for 1902 were £932,000; 1903, £1,657,114; and 1904, £927,336. Orders were taken during the first three months of the current year for £311,000, as compared with £210,000 for the corresponding period last year, notwithstanding the general depression, the keen competition at home, and "the vigorous efforts of Continental firms to secure British business." One director has retired for family reasons, and another is retiring from ill health.

The profit and loss account shows that the "profit for the year" is £50,550 2s. 4d. to which is added the reserve as per last account (£1,144 15s. 1d.), and transfer fees (£127 12s.), making £51,822 9s. 5d. together. Against this there are interest on loans and debentures £35,545 16s. 3d., experimental and other expenditure written off £2,966 17s. 3d., and depreciation written off machinery, &c., £10,500, leaving £2,809 15s. 11d. to be carried to balance-sheet.

The following shows the balance-sheet in a condensed form:—

Ordinary shares ..	£750,000	0	0	Patents and goodwill Works, machinery at Trafford Park, office furniture and sundry debtors	£794,867	2	2
Preference shares ..	2,500,000	0	0		2,301,320	4	3
Debenture stock, temporary loans, interest accrued, unclaimed dividends, &c., and premium on preference shares, and sundry creditors	1,269,684	6	5	Stock and materials on hand and in process of manufacture, balance due on work in progress, shares in other companies, and cash in hand ..	1,410,816	10	3
				Experimental, exhibition and sundry expenditure, patent fees, insurance, &c., paid in advance ..	15,460	5	8
Balance	2,809	15	11				
	£4,522,494	2	4		£4,522,494	2	4

To the best of our recollection the ordinary shares were allotted to the American Co., who have provided the experience, the technical advice, and the anticipations upon which the equipment was planned, and the works carried out. Further capital being required, the American Co. recognized their responsibility for the investment and backed their faith in the enterprise by the subscription of £500,000 in preference shares, and £400,000 in debentures. So that the interest of what we may call the "active" element is now of a far more important character than was the case when their holding consisted only of ordinary shares which had not involved cash subscription. The results, so far, must be very disappointing to the preference holders who were led to anticipate immediate dividends. It is to be regretted that the term "preference" was applied to shares which are more nearly related to ordinary capital than is usually the case with preference shares. We await with some interest the proceedings at the general meeting, when doubtless the shareholders will receive some further and fuller information as to their prospects. During the two years when active operations have been carried on, the position is that only the debenture interest has been earned, and in the accounts under review this amount has been shown only after including the estimated profit accrued on work in progress. We are afraid that too much importance should not be attached to the figures of orders booked in the first three months of the current year. We remarked, when considering last year's report, that "the directors will, of course, bear in mind that it is the profit resulting from the orders rather than the total of the orders themselves in which investors are mainly interested." It is an undoubted fact that the company has had to commence its operations in a period of depression and with keen manufacturing competition, but having made allowances for all that, the shareholders will have to consider whether Mr. Westinghouse's opinion that the company had not embarked upon too large an undertaking is to be entirely relied upon. It is important to consider whether Mr. Westinghouse could make the necessary corrections between his own experience in America and the conditions of business in England. Consideration on such points is necessary, even though all will agree that taken collectively there must be a large increase in electrical manufactures. We think that it was a mistake to expect immediate dividends from a manufacturing company of such a nature, and it would be a further mistake to build up expectations for the immediate future on the basis of experience, which may not apply to the conditions the company may have to meet.

West India and Panama Telegraph Co.

Mr. W. B. Kingsford (chairman) presided on Wednesday at Winchester House, Old Broad Street, E.C., over the fifty-fifth ordinary general meeting of the above company, and, in moving the adoption of the report, said the accounts for the half-year showed that the net receipts were £322 less than in the corresponding half-year. The actual traffics were £549 less, and there were several small increases in other items. The expenses were £386 more, so that the result was a decrease of profit amounting to £708, or about 2 per cent. of the receipts. This trouble was really a very small one, taking into account the fact that they had to maintain 21 stations and a fully equipped and necessarily expensive repairing steamer. Traffic receipts were the backbone of all telegraphic companies, and he regretted that there was not more elasticity in that part of their income. Their cables covered a very large area, extending from the Isthmus of Panama to Demerara, and it was not only a matter of regret, but a matter of surprise that the telegraphic facilities offered by their system were not turned to more account. For local purposes at all events, their rates were extremely moderate, seeing that between certain of the islands messages could be sent for 3d. a word. A much respected shareholder, who was unable to be present, had written suggesting that the interest upon the reserve fund investments should be placed to reserve, instead of being distributed in dividends. He heartily wished they could see their way to comply with that suggestion and thereby strengthen the reserve fund. They did place the interest to the reserve fund until June, 1899, when, after careful consideration, it was decided to place it to revenue as being, in their judgement, a course most beneficial to all classes of shareholders. The effect of adopting the suggestion of the shareholder who had written, would be to throw the dividends upon the first and second preference shares still further in arrears, and on that account they felt it would be undesirable to make any change in the present mode of dealing with the interest in question. In September last, taking advantage of a fortunate lull in their repairing operations, they chartered their steamer, the *Henry Holmes*, to the Cuba Co. for the purpose of repairing one of their cables, and they would derive a profit from this which would be dealt with in the accounts for the current half-year. The charter terminated on October 9th, and, by a singular coincidence, the cable between Trinidad and Demerara became interrupted on that very day. The next day there was an interruption of one of the Jamaica and Porto Rico cables; on November 9th two other cables broke down, and on November 20th, two more. This series of interruptions, occurring in rapid succession after three months of unbroken communication, could only be accounted for by some unusual physical conditions prevailing at the time. All these cables, with one exception, had since been repaired. They all knew of their unfortunate experience at Martinique and St. Vincent and the great difficulties they had to contend with in maintaining cables in these volcanic regions, but he sometimes feared that their friends in the Colonies, and those connected with the Colonies, did not so fully realise how great these difficulties were, and that it cost the company several thousand pounds every year to maintain its cables laid, as they, unfortunately, had to be on the sea bottom, which was probably more injurious to submarine cables than any other in the world. The Danish colonies of St. Thomas and St. Croix had renewed their subsidies for a further term of five years. Since he last addressed them, it was considered desirable in the interests of the company that he should go out to the West Indies and inspect their various stations, and make the personal acquaintance of the staff, many of whom he had never seen, and he also wished to become personally acquainted with the governors and other officials of the Colonies served by their system, and their principal customers. He was much gratified with the kindness and cordiality with which he was everywhere received, and he might be pardoned if he ventured to express the hope and even the belief that his visit would have a good effect in strengthening those friendly relations between the Colonies and the company, which it was, and always have been, their desire to establish and maintain. The chairman proceeded to deal with his visit to Colon and Panama, and said he believed that eventually the Panama Canal would be completed. How this would effect their company, however, it was impossible to say. When he was passing Martinique, the captain of the steamer pointed out where the *Grappler* went down on May 8th, 1902. During the whole time they were coasting along the island, the peak at Mont Pelée was invisible, owing to the steam being emitted, and two days later he heard that another serious eruption had taken place. This showed that they had acted very wisely in postponing the repair of the two cables which skirted the coast adjacent to the volcano, and they felt that it would still be very unsafe to take that work into hand. Shortly before his arrival at Guadeloupe a peculiar fault broke out in the cable connecting that island with Antigua. It was found to be in the shore end and under low water mark, and Mr. Moore, their clerk-in-charge, took the matter in hand with great energy and promptitude, and although the appliances available were very

inadequate, he succeeded in repairing it. Having referred to the brighter days in store for the West Indies now that the sugar bounties had been abolished and cotton growing started, the chairman said the total balance to be dealt with, including £710 15s. 1d. brought forward, was £13,679 13s. 8d. It was proposed to pay 7s. per share on account of the arrears of dividend to June 30th, 1904, on the first preference shares, which would absorb £12,097 1s., and carry £1,582 12s. 8d. forward.

Mr. H. Holmes seconded the motion, and it was adopted after a short discussion.

British Aluminium Co.

An extraordinary general meeting will be held on December 5th for confirming the special resolutions for capital reorganisation passed at the recent meeting. Resolutions will also be submitted to the meeting to the effect that the arrears of dividend accumulated on the 7 per cent. preference shares to November 22nd, 1904, be capitalised by the issue of certificates of £5 each, to be called "funding certificates," to carry interest at the rate of 4 per cent. per annum, to be cumulative as from December 31st, 1904; but such interest will be payable exclusively out of the surplus profits of the company which shall remain in any year after providing for the dividend for such year and arrears, if any (other than arrears to November 22nd, 1904), on the 7 per cent. preference shares in the company.

The directors will also ask power to borrow or raise £300,000, by the issue of 5½ per cent. "Loch Leven debentures," which will constitute a first fixed charge upon 50,000 shares of £10 each of the Loch Leven Water and Electric Power Co., and a second floating charge upon all the other property and assets of the British Aluminium Co., subject only to the £300,000 5 per cent. debenture stock.

It is also proposed that the capital of the company be increased to £500,000 by the creation of 38,000 new ordinary shares of £5 each, to rank *pari passu* with the existing ordinary shares of the company.

Northampton Electric Light and Power Co.

An extraordinary general meeting was held at Northampton last week to consider the advisability of simplifying the share capital of the company. The directors have for some time past had under consideration the desirability of re-arranging and simplifying the share capital of the company. In accordance with the advice of counsel, it is proposed that the several classes of shareholders should be empowered to make any alterations they may think fit in regard to the rights attaching to their shares. A resolution having this object in view was passed, and a further resolution will be submitted at a subsequent meeting.

Mr. F. H. Thornton, who presided, said that the directors wished to get rid of the founders' rights if they could, and they also wished to change the 6 per cent. preference shares into 5 per cent. preference shares. The reason for these proposals was that the company was getting on so well that it would be necessary for them to increase their capital very considerably in the future, and there was always a difficulty in getting capital for a company in which there were founders' rights. The directors proposed to give to the founders now a premium of 10 per cent. on their share capital; they would get £10 for every £100 ordinary first issue stock they held.

Western Telegraph Co.—Interim dividend of 3s. per share, or at the rate of 6 per cent. per annum, for the quarter ended September 30th, 1904.

May-Oatway Fire Appliances, Ltd.—The report for the period ended 12th ult. shows a profit, after providing for depreciation of stock and plant, of £2,033. The directors are now able to make good the deficiency of £1,765 which accrued during the earlier years of the company, when it experienced serious difficulties, which have now been overcome. Agency arrangements have been entered into with the Société Industrielle des Telephones, Paris, to develop the French patent rights.

Stock Exchange Notices.—The Committee has ordered the undermentioned to be quoted in the Official List:—

Calcutta Tramways Co., Ltd.—Further issue of 2,732 ordinary shares of £5 each, fully paid, Nos. 102,269 to 105,000.

Bullers, Ltd.—The report for the year ended July 31st, 1904, shows a net profit of £31,197, which, with £833 brought forward, makes a total of £32,031. The directors propose to pay a further 2½ per cent. on the ordinary shares, making 10 per cent. in all, to place £5,000 to reserve (which will then amount to £45,000), and to pay a bonus of 2½ per cent. on the ordinary shares, carrying forward £781.

Mond Gas Corporation.—The annual report shows a balance to credit of profit and loss account of £10,144. A dividend of 3½ per cent. per annum is recommended on the ordinary shares. £1,000 is to be written off preliminary expenses account, leaving £2,000 to be carried forward. The plant for South Staffordshire Mond Gas Co.'s first central station is on point of completion. Other important installations are at work, but the company's progress and profits have been adversely affected by depression in general engineering trade.

STOCKS AND SHARES.

Wednesday Evening.

Speculation having broken out wildly in South African and Egyptian mining shares, the investment sections are somewhat in the shade. Nevertheless, there is a lot of business doing amongst Industrial issues, and the Telegraph list has come to the front in rapid fashion. Its improvements are distributed with an impartial hand, and the speculative, as well as the sounder, shares, have taken part in the upward movement. Electricity Supply descriptions are also harder here and there, but Electrical Railway stocks appear to be ignored by the buyer and the seller equally.

As though eager to maintain the lead which it took in giving impetus to Telegraphs, the Anglo-American trio shows a return to better prices again this week. The Deferred continues the centre of an immense gambling account, which is said to spread from New York to Berlin. The price of the stock is talked considerably higher, and the wilder optimists hint at 20 as likely to prove an early goal. Of course, in a market so easy for manipulative ability to work, it is impossible to say how high Anglo "A" stock might not go, but unless there is something at the back of the rise which is hidden from most of us, the present quotation can scarcely be called modest. The Ordinary and the "B" stocks have both risen a little, and Direct United States shares are ⅛ firmer at 11. Direct Spanish Preference are ¼ up at 7⅞, and the Debenture rose a point to 101, while the Ordinary have just been admitted to official quotation, and are 2⅛. West African Telegraphs at 7⅛, Western Telegraph Ordinary at 13¼, and Great Northerns at 28½ have all added 5s. to their prices. Strong demand for West India and Panama second Preference put the shares ⅜ better at 6½, and the first Preference improved 5s. to 7⅝, although the Ordinary at 1 1/16 are among the very few to show a decline on the week. That the public are willing to take risks in this department is manifest by a ¼ rise in West Coast of America shares. The former are now 7/16, having more than doubled their quotation this week. Cuba Submarines are no less than 30s. and 20s. better for Preference and Ordinary respectively, on the reasons we mentioned in our last notes. In the Eastern group "China" shares are ¼ up at 13⅜, while Eastern Ordinary, in losing a point at 133½, practically comes into direct line with the former; it is many months since the two prices were so relatively close to one another. Globe Ordinary rose ⅛ in sympathy with the general firmness of the Telegraph market, but the Preference shares have not altered, nor have the Submarine Cables Trust certificates.

For the deplorable showing of the British Westinghouse Co., there were very few who professed to be at all prepared, and the price was knocked down 12s. 6d. to 2⅜. The Debenture stock, however, has only suffered to the tune of a point fall, to 89. It is unnecessary to say that the meeting will be awaited with an interest even more vivid than usual. Some few of the manufacturing shares are harder; Callender's for example, have put on ⅛ at 5¼, and Edison Ordinary rose a similar sum to 15s. Brush Ordinary and Preference are being inquired for, and the prices are both 5s. better at ⅜ and 1⅜. Does this mean some fresh British Electric Traction scheme? The preference shares of that undertaking rose ⅛ to 11. Crompton Debenture has been dragged into the light of day by a would-be buyer, and the price rose a couple of points to 94½.

Electricity Supply shares are curiously inactive in price, despite their attractions in the way of dividend returns and soundness of security. Edmundson's have got over the weakness caused by the new issue, and are back again at 6, after being 6¼. Westminsters drooped, and at 12⅜ are ¼ off. The proposals for getting rid of the founders' shares in the Charing Cross Co. has made no difference to the price of the other shares. Amongst provincials, Bournemouth and Poole Ordinary are ⅛ better at 12½, and Isle of Wight Electric Power Debenture—a 4½ per cent. stock—is slightly firmer at 101 middle. There was 1/16 improvement in Kalgoorlie Electric Power and Lighting Preference, which raised the shares to 9/16.

Railway stocks have fallen into disfavour once more, and the public are doing practically nothing in this market. None of the electric railway securities exhibit appreciable alteration, but Metropolitan Ordinary has risen ½ to 101, while Districts declined to 41½. There are several decidedly interesting schemes in the railway Parliamentary notices which have been published during the last few days. Holders of London United Tramways issues will look with some suspicion at the suggestion of the Great Western Railway to build a line from Acton to Shepherd's Bush. The comprehensive plan for an electric railway linking Hammersmith in the West with Southgate in the North has again been brought forward, but what the dwellers in the northern suburbs await more impatiently is the completion of the Great Northern, Piccadilly and Brompton and the Great Northern and Strand lines. The shares of the Piccadilly concern (Speyer's certificates) stand about 9, which is £1 discount. In the traction market, Anglo-Argentines have barely been affected by the strike. Calcutta Trams are ⅛ harder at 7⅞ middle.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1901.	1902.	1903.	Closing Quotations Nov. 23rd.	Closing Quotations Nov. 30th.	Business done week ended Nov. 30th, 1904. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	99 —102	99 —102	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	1 — 1⅛	1 — 1⅛	..	..
119,700	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	.. — ..	.. — ..	..	..
788,840	Anglo-American Telegraph	Stock	61s.	60/6	61s.	55 — 57	56 — 58	56	..
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	101 — 103	102 — 104	103½	101½
3,105,580	Do. do. do. Deferred	Stock	2s.	1/-	2s.	11⅜ — 12	12⅜ — 12⅝	12⅛	11¾
44,000	Chili Telephone, Nos. 1 to 44,000	£5	5 %	6 %	7 %	5⅞ — 6⅛	5⅞ — 6⅛	..	..
18,888,800§	Commercial Cable	$100	8 %	8 %	..	170 —190	170 —190	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	92 — 95	92 — 95	94½	94
16,000	Cuba Telegraph	10	4 %	6½%	5 %	7⅞ — 8¼	8⅜ — 9⅛	9¼	8½
6,000	Do. 10 % Pref.	10	..	..	..	15 — 16	16½ — 17½	17	15¼
12,931	Direct Spanish Telegraph, Ord.	5	..	..	..	2⅛ — 2⅜	2⅛ — 2⅜	2⅜	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7⅛ — 7⅜	7⅛ — 8	7⅛	..
80,000	Do. do. 4½ % Debs.	50	..	..	..	99 —101	100 —102	..	..
60,710	Direct United States Cable	20	3½%	3½%	3 %	10⅜ — 11	10⅞ — 11⅛	11	10½
81,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	100 —102	100 —102	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	133 —136	132 —135	134½	132
1,955,565	Do. 3½ % Pref. Stock	100	..	..	..	88 — 90	88 — 90	89½	..
1,584,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	105 —107	105 —107	..	..
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	13 — 13½	13⅛ — 13⅜	13⅞	13⅛
850,000	Do. 4 % Deb. Stock	Stock	..	..	..	106 —108	106 —108	..	..
800,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909	100	..	..	..	101 —103	101 —103	..	..
200,000	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	100 —102	100 —102	..	..
180,227	Globe Telegraph and Trust	10	5½%	£3 16 7*	5½%	9⅜ — 10	9⅞ — 10⅛	10⅛	9⅞
180,042	Do. do. 6 % Pref.	10	..	..	..	13¾ — 14	13¾ — 14	14	13¾
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	12½%	15 %	28 — 28½	28½ — 28⅞	28⅞	..
54,700	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	100 —102	100 —102	..	..
17,000	Indo-European Telegraph	25	10 %	10%	10 %	44½ — 46½	44½ — 46½	45	..
72,680	Monte Video Telephone Co., Ltd., Ord.	1	2½%	3 %	3 %	⅜ — ½	⅜ — ½	..	..
1,983,333	National Telephone, Pref. Stock	100	5 %	6 %	6 %	107 —108	107 —108	108	107
1,066,667	Do. do. Def. Stock	100	..	4½%	5 %	96½ — 97½	96½ — 97½	97½	96½
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	13⅞	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 13	12 — 13	..	..
1,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5¼ — 5⅜	5¼ — 5⅜	5 11/16	..
000,000	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	97½ — 98½	98 — 99	98⅜	98⅛
689,598	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	104⅛ —105⅛	104⅛ —10 ⅛	105⅛	105
1,000,000	Do. do. Prov. Certs., 35 % to be paid	..	..	..	..	67½ — 68½	67½ — 68½	67½	67½
179,318	Oriental Telephone and Elec. Nos. 1 to 171,636, fully paid	1	6 %	6 %	6½%	1/16 — 1/32	1/16 — 1/32	..	..
50,000	Do. do. do. 6 % Cum. Pref.	1	..	..	..	1⅛ — 1¼	1⅛ — 1¼	..	..
100,000	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	98 —100	98 —100	..	..
11,839	Reuter's	8	5 %	5 %	..	6⅞ — 7⅛	6⅞ — 7⅛	..	..
3,308	Submarine Cables Trust	Cert.	..	..	..	119 —122	119 —122	..	..
58,000	United River Plate Telephone	5	7 %	7 %	..	6⅜ — 6⅝	6⅜ — 6⅝	6⅜	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	5⅛ — 5⅜	5⅛ — 5¼	..	..
179,947	Do. do. 5 % Debs.	Stock	..	..	..	104 —106	105 —107	..	..
18,609	West African Telegraph, Shares	10	..	2 %	4 %	7 — 7½	7⅛ — 7⅜ xd	..	..
30,008	West Coast of America, 1 to 30,000 and 53,001 to 53,008	2½	..	..	..	⅛ — ¼	1/16 — 1/8	¼	¼
150,000	West Coast of America, 4% Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	..	..	..	98 —100	98 —100	..	..
267,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	7 %	13⅛ — 13⅜	13⅛ — 13⅜	13⅜	13½
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	101⅛—103½	102 —104	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	101⅛—103½	101⅛—103½	..	..
88,321	West India and Panama Telegraph	10	..	..	..	⅛ — ¼	⅛ — ¼	¼	⅛
84,568	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	7½ — 7⅞	7⅛ — 7⅜	7⅜	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	5½ — 6	6⅛ — 6⅜	6⅜	5½
40,000	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	101 —103	103 —105	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	5⅞ — 6⅛	5⅞ — 6⅛	..	..
10,000	Do. do. "A" 6 % Cum. Pref.	10	..	..	..	8⅞ — 9⅛	8¾ — 9¼	..	..
800,000	Do. do. 5½ 1st Mort. Deb. stock Red.	Stock	..	..	..	96 —100 xd	96 —100	..	..
100,000	British Electric Traction	10	9 %	8 %	..	9⅞ — 10¼	9⅞ — 10¼	10	9⅞
100,000	Do. do 6 % Cum. Pref.	10	..	..	..	10⅞ — 11	10⅞ — 11⅛	11	10 15/16
600,000	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	117 —119	117 —119	119	118½
	Do. do. 4½% 2nd Deb. Stock Red.	100	..	..	..	95 — 97	95 — 97	96½	..
100,000	British Insulated and Helsby Cables	5	10 %	10 %	8 %	5¾ — 6	5¾ — 6	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5¾ — 6	5¾ — 6	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red...	100	..	..	..	102 —105	102 —105	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	..	..	1/16 — ⅛	1/16 — ⅛	..	..
50,000	Do. do. 6 % Cum. Pref.	£1	6 %	..	..	14/6 to 15/6	14/6 to 15/6	..	..
105,781	Brush Electrical Engineering, Ord., 1 to 105,781	2	Nil	Nil	Nil	⅜ — ½	⅜ — ½	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	3 %	6 %	6 %	1 — 1¼	1¼ — 1⅜	..	..
125,000	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	93 — 96	93 — 96	95	..
125,000	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	69 — 73	69 — 73	..	..
85,000	Callender's Cable Construction shares	5	20 %	15 %	12½%	9½ — 10	9½ — 10	..	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5 — 5¼	5⅛ — 5⅜	5⅜	..
90,000	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	104 —106	104 —106	105	104½
1,860,014	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	93 — 95	93 — 95	93½	..
494,098	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	101 —103	101 —103	102	101½
494,998	Do. do. Def. do.	Stock	4 %	4 %	4 %	84 — 86	84½ — 86	84½	..
1,880,000	City and South London Railway	Stock	2 %	2½%	2⅜%	46 — 47	46 — 47	47	46⅞
85,000	Crompton & Co., Nos. 1 to 85,000	8	7½%	5 %	..	1½ — 1¾	1½ — 1¾	..	..
100,000	Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	90 — 95	92 — 97	96	..
99,261	Edison & Swan United Elec. Light, "A" shares, £8 paid, 1 to 99,261	5	Nil	Nil	..	⅜ — ½	⅜ — ½	..	..
17,189	Do. do. "A" shares, 01—017,189	5	Nil	Nil	..	1 — 1⅛	1 — 1⅛	..	..
344,028	Do. do. 4 % Deb. Stock Red.	100	..	..	..	78 — 83	78 — 83	..	..
100,000	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	79 — 84	79 — 84	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	6 %	4 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	..	..	..	2⅛ — 2⅜	2⅛ — 2⅜	..	..
82,500	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	98 —100	98 —100	..	..
95,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	9½ — 10	9½ — 10	..	..
800,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	91 — 96	91 — 96	..	..
200,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	15 %	10⅜ — 11⅛	10⅛ — 11	11⅛	10⅜
200,000	Do. do. 4½ % Pref.	5	..	..	..	5⅛ — 5⅜	5⅛ — 5⅜	5 3/16	..
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	109 —111	109 —111	..	..
60,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	20 — 20½	19⅞ — 20⅛	20⅛	20 1/16
800,000	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	99 —102	99 —102	..	..
87,500	†Liverpool Overhead Railway, Ord.	10	1½%	1½%	..	3⅜ — 3⅝	3 1/16 — 3 1/8	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10 — 10½	10 — 10½	..	..
87,850	Telegraph Construction and Maintenance	12	20 %	20 %	20 %	38 — 40	38 — 40	39	38½
150,000	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	102 —104	103 —105	..	..
540,000	Waterloo & City Railway, Ord. Stock	100	3 %	3½%	3⅜%	88 — 90	88 — 90	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List

(Bank rate of discount 3 per cent. (April 21st, 1904).

SHARE LIST OF ELECTRICAL COMPANIES (continued).— ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years 1901.	1902.	1903.	Closing Quotations Nov. 23rd.	Closing Quotations Nov. 30th.	Business done week ended Nov. 30th, 1904. Highest.	Lowest
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	£	8%	8 %	10 %	10¼— 11	10⅜— 11	10⅜	..
20,000	Do. do. 7 % Cum. Pref. ..	£	..	..	..	10¼— 10⅜	10¼— 10⅜	..	..
250,000	Central Electric Supply 4 % Guar. Deb. Stock	100	..	..	..	106 —109	104 —107 xd	..	..
50,000	Charing Cross and Strand Electricity Supply	£	10 %	10 %	8 %	8¾— 9	8¾— 9	..	..
70,000	Do. do. do. 4½% Cum. Pref. ..	£	..	..	..	5⅛— 5⅜	5⅛— 5⅜	5⅜	5⅜
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	£	..	..	..	4⅜— 5	4⅜— 5	4⅛	..
40,000	Do. do. 1903	£	..	..	..	4⅜— 5	4⅜— 5	..	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	103 —105	103 —105	..	..
44,436	*Chelsea Electricity Supply, Ord.	£	4 %	4½%	5½%	6⅛— 6⅜	6⅛— 6⅜	..	..
150,000£	Do. do. % Deb. Stock Red.	Stock	..	..	..	109 —111	109 —111	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595 ..	10	5 %	5 %	5 %	10¼— 11	10¼— 11	10⅜	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	..	..	..	13⅛— 14	13⅛— 14	13⅛	..
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid ..	..	..	..	..	128 —127	123 —127	..	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid ..	100	..	..	..	104 —106	104 —106	105	..
40,000	County of London Electric Lighting, Ord. 1—40,000 ..	10	4 %	4 %	4 %	9¼— 9⅜	9¼— 9⅜	..	..
20,000	Do. do. do. 6 % Pref., 40,001—60 ..	10	..	..	..	12 — 12⅛	12 — 12⅛	12⅛	..
400,000£	Do. do. 4½% Deb. Stock	..	..	..	..	107 —110	107 —110	108¼	..
250,000	Do. do. 4½% 2nd Deb. Stock	Stock	..	..	..	101 —103	101 —103	..	..
70,000	Edmundson's Electric Corporation, Ord. Shares	£	7 %	7 %	7 %	5⅞— 6	5⅞— 6⅛	6⅛	6
70,000	Do. do. 6 % Cum. Pref.	£	..	..	..	5⅞— 6	5⅞— 6⅛	6	5⅞
300,000£	Do. do. 4½% 1st Mort. Deb. Stock ..	100	..	..	..	106 —108	106 —108	107½	107
21,000	Kensington and Knightsbridge Electric Ord.	£	10 %	10 %	12%	12 — 13	12 — 13	..	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	102 —104	102 —104	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	£	..	..	..	2 — 2⅛	2 — 2⅛	..	..
49,840	Do. do. do. 6 % Pref.	£	..	..	..	5⅝— 5⅞	5⅝— 5⅞	5⅞	..
250,000£	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	97 — 99	97 — 99	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6¼%	7½%	8½%	16 — 16½	16⅛— 16⅜	16½	16⅛
71,106	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..	£	..	..	..	5⅛— 5⅜	5⅛— 5⅜	5⅜	..
220,000£	Do. do. 4½% 1st Mort. Deb. Stock ..	..	..	..	..	112 —117	112 —117	..	..
250,000£	Do. do. 5½% Mort. Deb. Stock Red ..	Stock	..	..	..	97 — 99	97 — 99	..	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	6 %	14½— 15	14½— 15	..	..
59,000	Do. do. 4% 1st Mort. Deb.	100	..	..	..	101 —103	101 —103	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	£	14½%	14½%	14½%	14½— 14¾	14½— 14¾	..	..
20,000	Do. do. do. 7 % Pref. 20,001 to 40,000	£	..	..	..	8¾— 9	8¾— 9	..	..
150,000£	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	99 —101	99 —101	..	..
12,000	Smithfield Markets Electric Supply, Ord.	£	..	2½%	4 %	2¾— 3⅛	2¾— 3⅛	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	..	..	..	83 — 87	83 — 87	..	..
65,000	South London Electricity Supply, Ord.	£	..	1½%	3 %	4⅛— 4⅜	4⅛— 4⅜	4⅛	..
100,000	South Metropolitan Electric Light and Power Ord.	£	..	..	..	⅞— 1	⅞— 1	..	..
50,000	(Late Blackheath and Greenwich 7 % Pref.	£	..	..	..	1⅛— 1⅛	1⅛— 1⅛	1⅛	..
100,000	Dist. E.L.Co.) 4½% 1st Deb. Stock	100	..	..	..	107 —110	107 —110	..	..
80,000	Urban Electric Supply, Ord.	£	..	..	..	4⅛— 5⅛	4⅛— 5⅛	5	..
80,000	Do. do. 5 % Cum. Pref.	£	..	..	..	4⅛— 5⅛	4⅛— 5⅛	5⅛	4⅝
200,000	Do. do. 4½% 1st Mort. Deb. Stock Red	100	..	..	..	103 — 105	103 —105	105	104½
110,000	Westminster Electric Supply, Ord.	£	10½%	12 %	13½%	12⅝— 13⅛	12⅛ — 13	13	12⅝
28,141	Do. do. 5 % Cum. Pref.	£	..	..	..	6⅝— 7	6⅝ — 7	6¾	..

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, November 30th.

CHEMICALS, &c.		Latest Price.	Week's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	32/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a ,, ,, ...	per ton	£30	..
a Bleaching powder	per ton	£5 5	..
a Bisulphide of Carbon	per ton	£15	..
a Borax	per ton	£18	..
a Benzole (90%)	per gal.	7/-	..
a ,, (50/90%)	per gal.	5/6	..
a Copper Sulphate	per ton	£23	..
a Lead, Nitrate	per ton	£25	..
a ,, White Sugar	per ton	£31	..
a ,, Peroxide	per ton	£27 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90% a 160° C).	per gal.	5/6	..
a Potash, Bichromate, in casks ..	per lb.	3d.	..
a ,, Caustic (75/80%)	per ton	£24	..
a Shellac	per cwt.	240/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70%) ..	per ton	£10 15	..
a ,, Crystals	per ton	£3	..
a ,, Bichromate, casks	per lb.	2½d.	..

METALS, &c.			
b Aluminium Ingots, in ton lots ..	per ton	£130	..
b ,, Wire, in ton lots ..	per ton	£168	..
b ,, Sheet, in ton lots ..	per ton	£166	..
b Babbitt's metal ingots	per ton	£48 to £140	..
Brass (rolled metal 2" to 15", basis	per lb.	7¼d.	..
c ,, Tube (brazed)	per lb.	9½d.	..
c ,, ,, (solid drawn)	per lb.	8¾d.	..
c ,, Wire, basis	per lb.	7¾d.	..
c Copper Tubes (brazed)	per lb.	10d.	..
c ,, ,, (solid drawn) ..	per lb.	10½d.	..
c Copper Bars (best selected ..	per ton	£81	..

METALS, &c. (continued).		Latest Price.	Week's Dec. or Inc.
g Copper Sheet	per ton	£81	..
g ,, Rod	per ton	£81	..
e ,, (Electrolytic) Bars ..	per ton	£70 10	..
e ,, Sheets ..	per ton	£87	..
e ,, Rod ..	per ton	£81	..
e ,, ,, H.C. Wire	per lb.	9¼d.	..
f Ebonite Rod	per lb.	8/8	..
f ,, Sheet	per lb.	8/-	..
m German Silver Wire	per lb.	1/6	..
h Gutta-percha fine	per lb.	8/-	..
h India-rubber, Para fine	per lb.	5/2 to 5/5½	1½d. inc.
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	47/8	1/6½ inc.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g Lead, English Ingot	per ton	£13 5s. to £13 7 6	..
g ,, ,, Sheet	per ton	£11 17s. 6d.	..
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£7 15	..
d Mica (in original cases) small ..	per lb.	6d. to 1/	..
d ,, ,, ,, medium	per lb.	2/6 to 4/-	..
d ,, ,, ,, large ..	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/- to 1/2½	..
p ,, rolled bars & rods	per lb.	1/- to 1/8	..
p ,, ,, strip & sheet	per lb.	From 1/1	..
o Platinum	per oz.	81/6	..
e Silicium Bronze Wire	per lb.	10d. to 11½d.	..
i Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i ,, ,, in bars		£16 to £40	..
g Tin, Block	per ton	£137 to £138	£4 inc.
g ,, Foil	per lb.	1/6	..
n ,, Wire, Nos. 1 to 16	per lb.	1/9	..
p White Anti-friction Metals—			
"White Ant" brand ..	per ton	£42 to £62	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j ,, 6 les. Flax	per lb.	5½d.	..
j ,, 3 ply 10 lbs. Russian ..	per lb.	4½d.	..
j ,, 10 lbs. Russian, single ..	per lb.	4½d.	..
j ,, 180 lbs. Jute rove ..	per ton	£11	..
k Zinc, Sh't (Vieille Montagne brd.)	per ton	£29 7 6	..

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co., *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

	Locality.	Week ending	Receipts for the week. £	Receipts for the week. £*	No. wks.	Total to date. £	Total to date. £*	Miles open.	*
Brit. Elec. Trac. Co.	Aberdeen	Nov. 26	1,024	— 52	26	38,489	+ 5,739	10	—
	Bath	,, 23	525	—	48	20,226	—	12½	—
	Birmingham ..	,, 26	4,861	—105	48	258,054	+13,854	8¾	—
	Blackburn ..	,, 25	707	+ 7	34	33,416	+ 3,296	13½	—
	Blackpool ..	,, 24	279	— 7	34	42,100	+ 5,913	8½	—
	,, —Fleetw'd	,, 26	170	+ 10	21	20,424	+ 891	7½	—
	,, —Lytham	,, 29	133	— 5	4	487	—	7½	+ ¾
	Bolton	,, 20	1,683	+ 45	88	68,372	+ 478	25	—
	Bournemouth ..	,, 23	742	— 36	34	39,052	—	10½	—
	Bradford	,, 19	3,715	+308	82	155,299	+26,268	54	—
	Brighton	,, 27	669	— 65	34	36,497	—	9	—
	Bristol	,, 25	4,354	+ 4	—	—	—	28	—
	Devonport ..	,, 19	469	+ 2	46	24,694	+ 3,284	5	—
Co.	Dudley—Sto'rb'ge	,, 18	761	— 7	46	40,261	+ 1,413	18½	—
	Gateshead ..	,, 18	891	— 10	46	42,005	+ 1,363	10½	+ ½
	Gr'n'k—Pt. Glsgw	,, 18	504	+ 41	46	26,769	+ 1,866	7½	—
	Oldham—Ashton	,, 18	512	+ 1	46	25,390	— 1,027	5	—
	Potteries	,, 18	1,764	+105	46	79,299	+ 5,814	28½	—
	South Staffs. ..	,, 18	673	—312	46	35,527	— 6,916	21½	— ½
	Swansea	,, 18	478	+ 9	46	25,109	+ 975	5½	—
	Wolverhampton ..	,, 18	362	+ 8	46	18,074	— 62	10½	+8
	Yorks. Wool Dist.	,, 18	485	— 40	46	27,094	+ 8,855	6	—
	Miscellaneous ..	,, 18	2,814	—	46	166,771	—	—	—
	Burnley	,, 26	912	+161	—	—	—	10½	+2½
	Burton-on-Trent ..	,, 20	209	— 26	33½	12,004	—	6½	—
	Cardiff	,, 13	1,902	+ 37	32	67,560	+ 1,664	14	—
	Chatham & District	,, 24	446	— 24	47	27,671	+ 2,165	8·13	—
	Cork	,, 24	361	— 24	47	24,127	— 2,689	9·89	—
	Dover	,, 26	146	— 12	47	10,986	— 986	3	—

* Compared with the corresponding period of 1903.

	Locality.	Week ending	Receipts for the week. £	Receipts for the week. £*	No. wks.	Total to date. £	Total to date. £*	Miles open.	*
	Dublin	Nov. 25	4,037	—260	—	108,947	— 2,993	47	—
	East Ham	,, 26	647	— 36	34	25,274	+ 1,422	6½	—
	Glasgow	,, 26	12,771	— 389	26	372,101	+19,779	72¼	+6½
	Halifax (2 weeks) ..	,, 19	2,635	+273	33	50,897	+ 3,872	34½	+2½
	Huddersfield ..	,, 19	1,182	+ 78	33	46,296	+ 2,986	26	—
	Hull	,, 26	2,042	+217	34	75,501	+ 9,833	13	+2
	Ilkeston	,, 23	97	— 29	34	4,934	—	3·5	—
	Ipswich	,, 26	290	—	34	17,357	—	10½	—
	Isle of Thanet ..	,, 26	222	— 85	47	39,658	+ 1,615	10½	—
	Leeds	,, 12	5,402	+296	92	194,676	+11,721	89½	+8½
	Liverpool	,, 19	10,075	+ 610	47	487,906	+14,031	103	—
	London C. C. ..	,, 12	12,886	+3072	33	417,611	+89,254	47½	+7½
	Manchester	,, 26	10,420	—549	34	422,201	+17,552	157½	+12½
	Newcastle	,, 26	3,429	+ 8	—	—	—	17	—
	Portsmouth	,, 26	1,229	— 61	34	70,400	+ 5,612	14½	—
	Salford	,, 21	3,728	+125	33	138,815	+ 8,267	30	—
	Sheffield	,, 27	4,095	—165	25	164,661	+ 3,075	84½	+1½
	Southampton ..	,, 24	780	— 67	34	34,477	— 2,196	16½	—
	Southend-on-Sea ..	,, 23	199	— 5	34	13,860	+ 1,354	6½	—
	Sunderland	,, 29	1,068	+ 93	34	44,547	+ 942	21	+1
	Tyneside	,, 23	310	—	47	18,380	—	8·9	+·4
	West Ham	,, 24	970	—	39	36,797	—	9·78	—
	Wolverhampton ..	,, 23	629	+245	—	—	—	9·5	—
	Cen. London Rly. ..	,, 26	7,229	+ 278	21	132,147	— 75	6	—
	City & S. Lon. Rly.	,, 20	2,963	— 67	21	53,775	— 1,914	6½	—
	Dublin—Lucan Elv.	,, 25	79	— 7	21	2,736	—1 80	6½	—
	G. N. and City Ry.	,, 26	1,846	+ 41	41	41,754	— 13	3½	—
	L'pool Overh'd Rly.	,, 27	1,426	—184	23	34,857	— 1,889	6½	+4½
	Mersey Railway ..	,, 26	1,889	+204	21	30,972	+ 2,553	4½	—

REVIEWS.

Electric Motors. By H. M. Hobart. London: Whittaker and Co. 12s. 6d. net.

This work is based on a series of articles contributed by the author to *Traction and Transmission*, and may justly be regarded as the latest word on the subject of which it treats.

The book is divided into two portions, the first dealing with direct current motors, and the second with single and polyphase machines.

In his opening chapter the author draws a comparison between direct and alternating current motors, which is somewhat unfavourable to the latter. The advantage claimed originally for the A.C. motor of having no commutator or sliding contacts has practically passed away, as in order to obtain a reasonable starting effort slip rings have been found necessary, and for single-phase work motors having commutators similar to those of D.C. motors have been found to do the best work. On the other hand, the original disadvantages of commutators on D.C. motors no longer exist, as with carbon brushes and correct designing, sparkless collection with fixed position of brush for all loads is easily attained. Pointing out the difficulties of speed regulation and lowness of power factor of the A.C. motor, the author expresses the opinion that in many cases it may be found desirable to generate polyphase current for convenience of transmission, transforming to direct current at the point where the power is applied. At the same time, having in view the numerous large power distributing plants at present being put down in this country, in which polyphase current will be generated and distributed, the author is of opinion that the demand for polyphase motors will increase.

In dealing with the design of shunt motors, the author advocates a design having a high average efficiency with varying loads rather than one constructed for a high full load efficiency. Thus, the all-day losses are minimised, which is an advantage to the purchaser of the machine, while machines of this design are cheaper to make, which is an advantage to the manufacturer.

As an example, the author gives comparative designs of two 100-H.P. shunt motors. The one machine has a liberal amount of iron, and, consequently, few turns of copper on the armature, and is a heavy and expensive machine. The other has the smallest possible quantity of iron, and so requires a large number of turns in the armature. It is, therefore, a light and cheap machine, but the $C^2 R$ loss in the armature at full load is high.

The heavier and more expensive machine has a full load efficiency of 90·5 per cent. The lighter and cheaper machine has a full load efficiency of 89·1 per cent. On the other hand, the "constant" losses (that is, core loss, $C^2 R$ loss in shunt and shunt rheostat and friction losses) total 2,700 watts in the cheaper machine, and 4,850 in the heavy one, so showing that the all-day efficiency of the cheap machine is higher than that of the more expensive one.

To carry the above principle of design into effect, it is necessary to know the extent to which the lessening of the iron for a given design may be carried. As the iron is decreased the turns of conductor on the armature must be increased, and owing to considerations of sparking, a point is reached beyond which the number of armature turns cannot be carried.

Sparking, however, depends not on the total number of turns on the armature, but on the turns per commutator bar; thus as the total turns are increased, the number of commutator bars must be increased also, and this increase may be carried on until the bars become as thin as is practicable. Thus, it may be said that, practically speaking, the limits of economical design correspond with the limit of thinness of the commutator bars.

The dependence of sparking upon the value to which the author has given the name of reactance voltage is very fully treated. The idea of utilisation of a reversing field to assist commutation is entirely discarded, and the author adopts a value of reactance voltage so low, that other causes tending to produce sparking may be neglected.

We notice that the reactance voltage of the author's present machines is much lower than in the case of those described in his previous work on Electric Generators.

Under types of windings, diagrams are given of the most usual forms of armature winding. In this connection the author shows that in the case of multipolar wave windings reactance voltage may be diminished by using as many sets of brushes as there are poles, instead of two sets only, which is the usual practice.

An interesting curve is given showing the relation of load and reactance voltage in a series motor. In such a motor the reactance voltage is not proportional to the load, owing to the fact that the speed decreases as the load rises.

Chapters on motor characteristics, motor designing and testing, and examples of motor design, contain a most valuable and original series of curves, together with drawings and sections of machines.

Following these the author has worked out a set of four comparative designs for a 35-H.P. motor in the fullest detail. These designs will well repay careful study on the part of designers who wish to achieve the best commercial results.

The portion of the book relating to D.C. motors concludes with a chapter on variable speed motors. In this chapter the author explains the principles which he advocates for the design of shunt motors, the speed of which can be varied by rheostat control in the magnet circuit. His previous explanations have, as the author states, been most curiously misunderstood. Put briefly, the author's method of design consists in dispensing with electro-magnetic commutation, and in making the reactance voltage at the highest speed at which the motor will be required to run, sufficiently low to avoid sparking. The remainder of the chapter is devoted to series machines, a very full description being given of the Johnson-Lundell traction system, in which series motors are used, having diverting resistances across the magnet windings for the purpose of obtaining changes of speed.

In the section on alternating current work, the author points out the advantages of high speed and low frequency not only for motors, but also for generators, as, in the case of the latter, owing to the smaller number of poles, a wider variation of speed in the prime mover may be permitted without fear of falling out of step when running in parallel.

The chapter on methods of starting induction motors will be useful to those who are endeavouring to devise more satisfactory methods of starting than those in use at present. The arrangement which the author appears to prefer is a squirrel-cage motor (owing to the high running efficiency of this type), with compensator or auto-transformer for starting, and with some form of centrifugal clutch which will permit of the motor starting light, the load being put on gradually and automatically as the speed increases.

Where, however, starts have to be made frequently under load, slip rings and external resistances become necessary.

Several less-known methods of starting are described. Görges' method consists in so arranging the secondary windings that the E.M.F. in some of them shall oppose that in others in the same series circuit, thus leaving a residual E.M.F. sufficient to send a suitably small current through the total resistance per winding. When the motor is up to speed, the connections are altered so that the full E.M.F. of each winding is utilised. With this arrangement, no external starting resistances are necessary.

Mr. Hobart has himself devised a starting method on somewhat similar lines.

Boucherot, taking advantage of the fact that at the moment of switching on the current the periodicity in the rotor is a maximum, and that it falls to its minimum value as the motor attains full speed, avoids the use of starting resistances by providing his rotors with two windings, the one having high resistance and low inductance, and the other high inductance and low resistance.

The author has also proposed to utilise the variation of periodicity to obtain starting torque by means of skin effect in the rotor conductors.

Zani has invented a method in which inductance coils are mounted inside the armature spider and connected permanently in series with the rotor windings. As the motor attains speed the magnetic circuit of the inductance coils is

broken by means of a centrifugal device. Fischer-Hinnen has devised a method of combined reactance and resistance for starting.

In the chapters on designs of induction motors and examples of designs, interesting curves and data are given, as in the case of D.C. motors in the first section.

Tables of resistances, &c., are given at the end of the book.

C. W. H.

Smoke-prevention and Fuel Economy. By W. H. Booth and J. B. C. Kershaw. London: Archibald Constable and Co. 6s. net.

"What a price for a book of less than 200 pp. on boilers!" says the kind of engineer who takes his boiler house for granted, and worries his life out over the energy lost in the ammeter shunts on his switchboard.

That is the man whom the authors have been trying to teach for years. Gradually they and their disciples, or co-apostles, are making their voices heard in the smoky wilderness where roam in bands the station engineers of England, headed by the consultants who suckled them, all employed in raising their station load-factors by veiling the sun at noon.

One knew that Mr. Booth must write this book sooner or later, and his collaboration with Mr. Kershaw makes it all the more acceptable now that it has come.

Originally intended as a translation of a German book by Ernst Schmatolla, it is only necessary to read it to be sure that the imprint of the authors is plain on every page. To English readers we would say that this book is a modern counterpart of "The Combustion of Coal," by C. Wye Williams, which should be read by every engineer in his cradle.

An introduction is written round the text of the volume "There is no need for smoke." The book proper opens, logically enough, with a clear exposition of the chemistry of the combustion of coal. The second chapter is concerned with modern methods of furnace construction. For successful construction four cardinal precepts are laid down. They have been well known for years to all who have taken any intelligent interest in the subject, but the number to whom they are unknown, or by whom they are unappreciated, is quite astonishing; and the most peculiar thing is that nine out of ten patentees of boilers are among the number. As it was in the days of Williams, so it is now. He preached (1) sufficient draught, (2) efficient air mixture, (3) high temperature and roomy space for combustion, until the very deaf might have heard; but it is no superfluous reiteration when Messrs. Booth and Kershaw preface their second chapter with these conditions. Could rules be simpler, and could they be more persistently disregarded?

There are engineers with hundreds of horse-power of boilers under them to-day who hardly apprehend why the fire in a domestic grate clogged with ash will not burn briskly, and their very use of the poker is unintelligent. Is it to be wondered at, then, that Welsh coal is offered for delivery into the heart of every bituminous coalfield, and that Metropolitan police-courts never cease echoing the cry that every possible means of preventing smoke—and black smoke at that—has been tried without success.

The great defect of the Lancashire or Cornish boiler is the water-cooled furnace, and the only complete solution seems to be an external furnace such as is shown on p. 53, for the other expedient mentioned—lining the furnace itself with fire-brick up to and beyond the bridge—costs too much in repairs, and often reduces too seriously the grate and furnace area.

Even the Babcock boiler—so much the fashion in central stations—may be made smokeless, without reducing in the least its quick-steaming qualities; and it is worthy of notice that the modifications necessary to obtain this result were not introduced by the makers, but by a more than usually intelligent user.

When referring to the Babcock boiler with a certain disrespect, we did not intend to convey an impression of its inferiority to other water-tube boilers, for although the principles of combustion are not acknowledged sufficiently in that boiler, most of the others have committed even worse faults in design.

Chapter 3 discusses and describes the available antidotes to the defects exposed in the previous chapter. Special attention is given to step-grates, gas-firing, and forced draught.

Chapter 4 on the examination of the products of combustion, or of non-combustion as the case may be, is the longest and the most interesting in the book. Excellent illustrated descriptions of instruments for observing or recording temperatures, draught and composition of gases—the tell-tales of boiler efficiency—are given, and no erring engineer can read it who will not with all speed assail his committee or directors with requisitions for the best of them. May they all be blessed with the spirit of importunity, so that they may at last prevail. Perhaps, indeed, we have been too sweeping in our strictures regarding the intelligence of the station engineer. Let us say rather with our authors:—"Controlled by committees of no scientific or technical knowledge, or by boards whose ideas have not extended beyond questions of barest first cost, those who have known better have, perhaps, found themselves hampered for want of sufficient appropriations to put in really correct plant." That at least is more sympathetic.

With great good sense the authors have relegated the major portion of the descriptions of different boilers to an appendix. Such descriptions are almost essential to a work like this, but most readers object to the main text being overrun with patent abstracts. None of the patented designs reproduced are criticised, the reader being invited to utilise the knowledge gained in studying the book, to judge the value of each for himself. No better examination paper could have been set.

Appendix 2 contains four valuable tables, the first showing how vain a thing it is to burn Welsh coal solely to avoid the outward sign of imperfect combustion, for the calorific value per 1d. of cost is 39, as an average of 14 samples of Welsh coal, and 73·6 for 15 samples of soft bituminous coals.

The fourth table is the shortest and most significant; readily understandable, too, by directors and committeemen. It sets out, in terms of tons of coal and money, the actual losses incurred in most boiler plants due to imperfect combustion.

Certainly no engineer, who has to do with boilers in any way, should fail to read this book.

THE THEORY OF ELECTROLYTIC DISSOCIATION AT THE FARADAY SOCIETY.

Prof. Louis Kahlenberg, of Wisconsin, well known as one of the ablest and severest critics of the ionic theory of solution, as elaborated by Van't Hoff, Arrhenius, and others, presented a paper to the Faraday Society at the recent meeting, held on November 23rd, in which he summed up all the objections that have been raised against the theory within the last few years, and, in particular, the criticisms based on the splendid experimental work that has been carried out under his able guidance in the laboratory of Physical Chemistry at the University of Wisconsin. The paper, which, in the regrettable absence of Prof. Kahlenberg, was read in abstract by the secretary, is entitled "Recent Investigations bearing on the Theory of Electrolytic Dissociation," and it occasioned a most interesting discussion, from which, it must be confessed, the theory certainly emerged triumphant.

It may be useful to outline here the arguments on which the theory of Arrhenius is based. The theory, which in its present form, was first put forward in 1887, states that when a salt, for example, sodium chloride, which in solution forms an electrolyte, is dissolved in water, a portion of its molecules are *dissociated* in solution to form free ions; in the present instance sodium ions are charged positively, and chlorine ions charged negatively, and when a current of electricity is passed through the solution, it is these ions which actually carry the current, and which, on giving up their charges at the cathode and anode respectively, are there set free as molecules of the two elements. Arrhenius further

showed that in dilute solutions it was possible to measure the proportion of total solute present, which had been dissociated by the solvent. The general reasoning on which the existence of such free ions in solution is based, is somewhat as follows. The fact that the products of electrolysis appear only at the electrodes, leads to the Grotthus chain hypothesis in some form or other. Faraday's laws suggest opposite convective streams of anions and cations. Hittorf's observations on the unequal concentration of the solution around the electrodes caused by electrolysis, lead to the conception either of complex ions, dragging along with them salt or solvent, or else unequal velocities of the ions, the ratio of which can be measured. Kohlrausch's measurements of the resistance of electrolytes, combined with Hittorf's figures, enable the absolute velocities to be calculated, since the total electric transfer per second—that is, the current—is equal to the product of the number of ions, the charge on each, and the sum of their absolute velocities. Now, electric conduction in solutions obeys Ohm's law, after polarisation effects have been eliminated, and therefore any force, however small, must produce a corresponding current. Hence the E.M.F. between the electrodes must be merely directive, and the ions must necessarily have migratory freedom. Such migratory freedom may be pictured as occurring in two possible ways: either the ions may interchange and be passed along the solution at successive collisions between molecules, so that ions are never for any length of time free, or else a certain proportion of the molecules may be permanently dissociated. The former is the theory of Clausius, and the latter the famous dissociation theory of Arrhenius. It was the application of van't Hoff's theory of solution to the case of electrolytes, that first led to the adoption of the dissociation theory of Arrhenius in preference to that of Clausius. Van't Hoff had shown that the osmotic pressure—that is, the pressure of the molecules in solution—exerted by a substance in dilute solution, could be calculated from the well-known equation of gases $PV = RT$. But when this law came to be applied to solutions of electrolytes, it was found that a factor i (greater than unity) had to be introduced, so that the equation became $PV = iRT$. Now the discrepancy is easily and beautifully explained by the dissociation theory, for, if that be true, the number of *effective* molecules in an electrolyte will be greater than in a corresponding solution of a non-electrolyte, such as sugar, and thus the resulting solution pressure will be correspondingly increased. The factor i is, in fact, obviously a measure of the relative number of ionised molecules. Moreover, the factor i increases with dilution, and this agrees with the observation that the *molecular* conductivity (*i.e.*, the specific conductivity multiplied by the dilution) of electrolytes increases with dilution until a point is finally reached when the factor i becomes equal to 2, showing that complete ionisation has then taken place. It is only in exceptional cases that osmotic pressure can be measured directly, but the proportional number of effective molecules in solution can be calculated by applying the laws of thermo-dynamics, from observations on the depression of the freezing points of solutions, the elevation of their boiling points, or the lowering of their vapour tension, and such observations according to the exponents of the theory of Arrhenius, confirm the presupposed differences between solutions of electrolytes and solutions of non-electrolytes.

Now, Prof. Kahlenberg contends that the theory is supported by isolated observations only, and that the bulk of evidence gathered since 1887 speaks very strongly against it. In particular, he quotes an elaborate series of experiments made by himself in 1901 with typical electrolytes and non-electrolytes, and maintains that these show no such connection between freezing points and boiling points on the one hand, and molecular conductivity on the other, as is claimed by the theory of dissociation. The reply of the exponents of the theory to this contention is that the solutions used were not sufficiently dilute to warrant *numerical* application of the hypothesis. As Dr. T. M. Lowry, in the discussion last Wednesday week pointed out, it is not that the theory does not hold good for strong solutions; on the contrary, it holds good for solutions of all strengths, it is only that the means at our disposal do not enable us to *measure* the degree of ionisation excepting in cases of xtreme dilution. Both Dr. Lowry and Mr. W. C. D. Whetham, in his admirably cogent and lucid statement, referred to experiments of Griffiths with very dilute solutions. That experimenter has shown that freezing points of solutions of sugar are very accurately those deduced from the gaseous value of the osmotic pressure, while those of solutions of potassium chloride give exactly double values. This result imperatively calls for an explanation involving some kind of binary dissociation, which the theory of Clausius does not give, but which that of Arrhenius does. Another point of great importance put forward by Mr. Whetham, throws the scales heavily in favour of a dissociation theory rather than one of ionic interchanges. If the latter were true, it can be easily shown that conductivity should be roughly proportional to the cube of the concentration, whereas it is in reality proportional to the first power of the concentration, as would follow if the ions were entirely free of the molecules of the solute.

Prof. Kahlenberg quotes several properties of solutions, such as colour, power of causing instantaneous reactions, and power of causing coagulation in solutions of colloids, that have been ascribed to the action of the free ions present, and he shows that such qualities persist even in certain organic solutions that do not conduct at all, and in which, therefore, there can presumably be no free ions. The first of these objections was dealt with by Prof. Abegg, who sent in a valuable contribution to the discussion, and by Dr. G. Rudorf. Prof. Kahlenberg urged that the blue colour exhibited by a copper salt in benzene solution, which is insulating, is proof against the theory. Not at all, says Prof. Abegg; "all copper ions must be blue, but all blue things are not necessarily copper ions!" It is only necessary to make with Dr. Rudorf the perfectly natural assumption that the molecule of copper sulphate has nearly the same light-absorbing properties as the ion, and all difficulties vanish. The second of the above objections is overcome if only very few ions——such as could not be detected by conductivity measurements—are present in solution. The third difficulty is again a result of faulty logic. Clear connections have been traced, said Mr. Whetham, between the coagulative powers of salt solutions and their electrical properties, and it has been shown that chance conjunctions of free ions would lead to the observed results; but that does not prove that no coagulation can occur unless it be by the action of ions! Moreover, as pointed out by Prof. Abegg, none of these qualities claimed by some people for ions are an integral part of the dissociation hypothesis.

Guldberg and Waage's law of mass-action, which treats of the influence of mass on chemical equilibrium, has been extended by Ostwald to electrolytic dissociation, and has led to the enunciation of his well-known dilution law, $\frac{a^2}{v(1-)a} = K$, where a is the ionisation, and v the volume of solution containing one gram-molecule of electrolyte, and which, therefore represents the effect of dilution on the ionisation of binary electrolytes. Prof. Kahlenberg maintains that the agreements obtained in the application to solutions of weak organic acids are very rough, and to electrolytes *par excellence* it cannot be applied at all. Prof. Abegg, in reply, says we have every reason to believe the contrary. It has been shown that the law holds good for strong acids, such as picric, by only measuring the un-ionised part by a sufficiently accurate method, and Jahn has made it probable that conductivity is not an exact measure of the degree of ionisation—which depends also on the mobility of the ions among other things—and that this inexact assumption answers for the apparent differences in the case of strong electrolytes from the law of mass action.

Prof. Kahlenberg considers that it is in the realm of non-aqueous solutions that the theory proves especially impotent, and he quotes cases where such solutions conduct electricity even better than aqueous solutions, yet yield higher molecular weights than those computed from the formulæ of the solutes. Here, at last, some of his critics seemed disposed to agree with him—up to a certain stage. Says Prof. Abegg: "The theory of ionisation was detected, because of the relative simplicity of the behaviour of aqueous solutions; it is not sufficient to explain the much more complicated behaviour of non-aqueous solutions, but it is too much to say that it must on that account be discarded." It is true

that some enthusiastic disciples of Arrhenius have applied the theory to non-aqueous solutions and other cases which apparently do not justify such application, but as Dr. Borns remarked, it is not logical on that account to attack the theory as if everything ever written in its favour formed a chapter of an orthodox Bible. It is, however, only fair to point out that even in non-aqueous and badly-conducting solutions, the solute *may* be ionised, because ionisation is by no means the only factor that determines conductivity; mobility has already been referred to, and there are hydrolysis, the association of the ions with the solvent, molecular friction, and other phenomena, which may be even more important factors than only the number of ions present. The application of the theory to the case of fused salts—which puzzles Prof. Kahlenberg, as such substances may be considered 100 per cent. solutions—is a similar case in point. It may be, explained Mr. Whetham, that the method by which the migratory freedom of the ions is produced in fused salts differs from the process in aqueous solutions of those salts, but here further evidence is needed before any conclusion can be arrived at. We have, indeed, at present, no means of finding what the coefficient of ionisation is; perhaps some, perhaps even all, of the molecules of a fused electrolyte are dissociated. Why dogmatise on such an unknown problem?

Prof. Kahlenberg finally puts forward a theory of solution which is not unlike that outlined by Prof. Ostwald last year, in his now famous Faraday lecture to the Chemical Society. In the course of the discussion it was pointed out by Mr. F. S. Spiers that Traube had recently described a similar theory of solution, in which, however, he gave *numerical* expression to the views about to be described, and in which Arrhenius's coefficient of ionisation, *i*, is interpreted as a measure of the affinity between solute and solvent. Prof. Kahlenberg contends that the dissociation theory must give way to a conception which takes into account the affinity—of the same nature as chemical affinity—between solvent and solute. "*The processes of solution and chemical action are identical in character, and chemical compounds are merely the cleavage pieces of solutions placed under special stress or duress represented by the so-called purifying processes.*" Thus chemical action is merely a special case of solution, and the process of solution is the general case of the interaction of bodies resulting from their specific attractions for one another. A dilute solution is merely a limiting case. The abnormal value of molecular weights of substances in solution as determined by change of vapour tension, freezing or melting points, is merely a measure of the affinity between solute and solvent, and has nothing to do with any supposed dissociation; the calculation of molecular conductivities is founded upon the erroneous supposition that the solvent plays no part in the conduction. Recent determinations of osmotic pressures by the author have similarly shown that these depend on the nature of both membrane and liquids, and are by no means in accordance with the requirements of the gas laws. Here, again, as in solutions, *affinity* is the determining quantity.

From the point of view of dissociation, Prof. Kahlenberg's proposed new theory was received by his critics with hardly greater sympathy than his strictures on the old hypothesis. "Such a view," said Mr. Whetham, "I heartily agree with, but it leaves untouched the question as to the nature of an electrolyte." It is highly probable that there is some kind of chemical union—call it association, or hydrolysis, if you will—between solute and solvent, but the electrically charged parts of the molecules of the former may still, nay, *must* still, possess the migratory freedom assumed by the theory of Arrhenius, if we are to explain satisfactorily the known facts of electrolysis and migration. We cannot do better than end this article with the following weighty words of Prof. Abegg:—"If one wishes to overthrow any successful theory, it is not sufficient for the progress of science to point out difficulties—in that case, no one theory in science would be valid—but it is necessary to find another theory likely to explain not merely the difficulties of the old one, but also the many phenomena and observations already embraced by it," and it is precisely that, which the opponents of the theory of dissociation have so signally failed to do.

THE INSPECTION OF A HIGH-SPEED ENGINE AFTER OVERHAULING.

By A POWER-HOUSE ENGINEER.

High-speed engines have obtained an unfortunately bad name in some quarters in regard to cost of repairs, partly because the usual locomotive or marine engine fitter fails to grasp the peculiarities in clearance allowances, valve setting, and such like, pertaining to the high-speed engine, and partly because those in charge of its running fail to notice signs of trouble in time to avoid a breakdown, owing to the enclosure of the working parts.

It is not surprising that, when a mishap does occur, fitter and driver try to lay the blame on one another. It is, therefore, the duty of the engineer in charge of the plant, before running up an engine for the first time after it has left the fitters' hands, to thoroughly examine it in order to assure himself, as far as possible, that the engine has been placed in good working order before the driver is called on to use it. The following method of examination, or such parts of it as fit each particular repair, may be usefully adopted.

Suppose that the moving parts of the engine have been completely taken adrift and are now re-assembled, the cylinder and valve covers being yet removed, the crank chamber being opened as much as possible, steam and exhaust main and bye-pass valves shut. The engineer should get the fitter to produce his "leads" of the clearances in the main bearings, cranks and cross-heads, or, if not satisfied, he should obtain them himself by taking off the cover and top brass of the bearing, and placing two or three pieces of lead wire of larger diameter than the required clearance, longwise on the shaft at intervals apart. Then, on tightening down the top brass on to its liners, slacking back again, and examining the thickness of the flattened lead wire, the clearance can be gauged. In some cases a feeler of thin strip-steel can be inserted between the brass and journal, the known thickness of the thickest strip which can be inserted, giving the clearance. In high-speed enclosed engines, owing to the great temperature-range to which the metal parts are subjected, the clearances are left more than ample according to the idea of men accustomed to open-type engines. For example, $\frac{1}{50}$ in. is a reasonable clearance between the crank-pin and brasses. The tendency to knock is overcome either by buffering the surfaces with oil under considerable pressure (as in the Belliss type) or by obtaining a uni-directional thrust in the bearings by air buffers as in the Willans type.

The clearances at the top and bottom of the cylinders should be tested as follows:—Set the crank corresponding to the cylinder to be tested, on its top dead-centre, and scribe in the guide the position of the bottom edge of the crosshead. Or alternatively scribe it on any smooth upright portion of the standard by placing a centre-pop-mark on a convenient part of the piston-rod and using a pair of trammels. Repeat this for the bottom centre. This gives the length of the stroke. Now disconnect the piston-rod from the connecting rod and push the piston up till it butts against the top cylinder cover. Again scribe the position of the crosshead or the pop-mark. Lower the piston till it rests on the bottom of the cylinder, and again scribe. The distance between the top pair of marks gives the top clearance, and similarly the bottom clearance is shown by the spaces between the lower pair of marks. The engine makers usually stamp the prescribed clearances on the engine, and the length of the piston rod must be adjusted till these values are obtained. The top clearance, in a quick-speed vertical engine, is usually about a half the bottom clearance.

The average fitter or engineer will probably make a mess of the valve-setting of a high-speed engine, though he may not like to be told so. The fitter will probably proceed on a trial-and-error method, searching for knocks in the cylinder while running by resting a light piece of wood against his teeth, and touching various parts of the engine with it. When he has got rid of the knocks, he is quite happy, irrespective of the amount of steam used to get the work out of the engine. The engineer, on the

other hand, will probably try to locate the trouble by means of cards. Apart from the fact that an accurate card is very difficult to take on a high-speed engine, owing to inertia of the indicator mechanism and similar causes, the card, when taken, is quite useless unless the engineer has previous experience of the peculiarities of the engine. The effect of the inertia of reciprocating parts is so enormous as to oftentimes require an altogether distorted card to overcome it. If the valve-gear was in good running order before the engine was overhauled, the engineer should see that the parts are reset to marks on the crank-shaft (for angle of lead) and engine framework (for position and length of travel of valve by means of a pointer butting against the valve and reaching to the nearest straight stationary surface) made before taking the engine adrift. Where the valve has been altered, by inserting washers on the spindle to make up for wear, by using rings of different thickness (in piston valves) or chipping the surface of the valve, to alter the lap and lead, the engineer should by means of a template measure the actual amount of lap and lead in each valve, and see that these measurements correspond with the figures given by the makers of the engine. A manufacturer may be trusted to send out his engine from the works with the best arrangement for admission and exhaust that he can find, and it is only necessary to restore the engine to that condition. Preferably, before the governor springs are put on, the governor gear should be tried by hand to see that it is working quite freely. All the stop valves and cocks on the engine (with the exception, of course, of the main and bye-pass steam and exhaust valves) should be tried to make sure that they open and shut easily and smoothly. Every nut and lock nut should be tested with a spanner to see that it is tight, and wherever there should be a split-pin to secure a nut to a bolt, care must be taken to see that it is there, with its ends properly opened out. With a little experience, it can be recognised whether a nut is tight or slack by its ring when it is lightly tapped with a hammer.

The crank chamber should now be thoroughly searched for any odd nuts or other parts, and for any pieces of waste, metal chips and such foreign matter. If a nut or a pin is found there, the engine must be examined afresh to see if any part is lacking it. Having cleaned out the chamber as well as possible with rag, it should be washed down with paraffin—the motion also getting a share of the oil. This should then be cleaned out with dry rag, waste being preferably left at the other end of the engine room, as small bits of fluffy material in a crank chamber will explain the worst kind of accident. All oil strainers should be cleansed with paraffin, and in those types of engines which depend on forced lubrication the oil pump should be examined, and all union joints on the pipework should be tested for tightness. Any leak in the system diminishes the pressure of oil available for the bearings. The cylinders and valves chests should now be given a good quantity of heavy black oil, and the crank chamber should be filled up with a lighter oil. Nearly every engine builder has his favourite crank chamber oil, and if he can have his way he will have new oil put in every time the chamber doors are taken off. The engineer can with some experience tell whether the oil is fit for another run. A castor-oil and water emulsion smells rancid and looks a bilious yellow when it is going bad. Mineral oils, when overwrought, form a mixture with the water which always finds its way into the crank chamber, described as "pudd'ny" by the drivers. The quantity to be put in is gauged by experience; in forced-lubrication engines the cranks should clear the surface level; in splash-lubricated engines the cranks should dip into the bath at least 2 in.

The cylinder and valve covers being replaced and jointed, the engine should be slowly barred round a few times. Should any part be bearing unduly on another, a jarring or grinding noise will be heard. Should anything be out of place—for example, the cylinder clearance wrong—the engine will refuse to complete its revolution. Should this test, however, be satisfactory, the engine is ready for careful warming up. If the exhaust main opens on to a vacuum, the engine should be "scotched" in order to prevent its turning before its time. The bye-pass on the steam valve should then be opened slightly to allow sufficient steam to pass to warm the engine up slowly. If a few hours can be allowed, so much the better. The re-made steam-joints should be "followed up" with a spanner as they get warm, and any leaking joints should be made tight. Where it is possible, as when the exhaust is on atmosphere, the engine should be barred round a few times during warming, to make sure that all parts of the cylinders and valve gears become equally heated. On a vacuum this may be managed by shutting off the warming-valve, nearly closing the exhaust, and removing the "scotch." The engine will then turn over till the exhaust is closed entirely. Re-scotch the engine and proceed as before. During the warming process all steam-traps should be tried by hand to make sure that they are working properly. Gradually open the bye-pass till full-pressure steam is on the engine, then open the main stop valve slightly and allow the engine, if of the forced-lubrication type, to turn for some time as slowly as possible. Oil pressure, as shown on the gauge, should be noted, and all bearings incessantly watched. They should be felt often to catch the first sign of heating. The splash-lubrication engine should be allowed to turn at about quarter-speed, when splashing commences. A syringe should be used to squirt oil on the higher parts of the motion.

The cylinder and valve rods should be well swabbed with heavy oil, and the cylinder oil sight-feeds should be allowed to run with a full stream of oil. If no heating occurs anywhere the crank-chamber doors should be replaced and the speed increased, the working parts being carefully watched through the observation doors. After the engine has run for, say, six hours at full speed, unloaded, the chamber doors should be removed and all parts of the motion strictly examined for heating, and looseness of bolts, nuts, and pins. If this examination proves satisfactory, the engine is ready for load, but after a few days' run the cylinder and valve covers should be again removed, and the pistons, cylinders, and valves examined for scoring of their surfaces and tightness of nuts. If practicable, the more important bearings, such as those in the crossheads, cranks, and main engine bearings should have their covers taken off and the bearing surfaces examined.

It may seem that the above process is rather long and complicated; it is, however, just the avoidance of careful inspection that breeds so many disasters to high-speed plant. A driver who has his engine open before him does not neglect to feel round the bearings at least twice an hour. Why, therefore, should it be expected that an enclosed engine should run at twice or four times the speed without adequate inspection?

OIL FOR TRANSFORMERS, SWITCHES, &c.

By E. KILBURN SCOTT, A.M.I.C.E., M.I.E.E.

Whilst attending the Transmission of Power Section of the St. Louis Congress, the writer took the opportunity of inquiring how oil for transformers and oil switches, &c., was treated. It will be remembered that the early experience with oil transformers in this country was not satisfactory, and possibly this, as well as the fact that we do not require transformers of very large size, are reasons why oil is so seldom used.

The oil employed in America appears to be in all cases a special refined mineral oil free from water and acid. Rosin oil, which we have used in England, does not appear to be a familiar term to American engineers, at any rate, those the writer asked had never heard of it.

Presuming the oil to be neutral, water is, of course, the principal drawback, and not only must such oil be specially treated to thoroughly free it from water, but special care must also be taken to see that water does not get in afterwards. Many failures have been traceable to water getting into the barrels during transport, and the only reliable way is to forward the oil in watertight drums.

There are various methods of drying, but perhaps the best one is to place the oil in a large tank having a resistance coil suspended in the centre. After the current has heated up the oil, air is blown through it from a motor-driven compressor, the air having been first thoroughly dried by passing it over chloride of lime. As the small bubbles pass upwards through the oil they take up any

moisture that may be present. In the case of a very large tank, it is as well to also agitate the oil mechanically, so as to ensure all of it coming into contact with air.

After drying, a flashing test is made, and this, of course, varies according to the voltage to be employed. It may be taken, however, that no oil is considered satisfactory which will not withstand at least 30,000 volts alternating between two flat surfaces 1¼ in. in diameter and ⅛ in. apart.

After passing the test the sooner the oil is placed in the transformer case the better, and for this reason some power companies dry the oil themselves in the main station or sub-station as the case may be.

After the oil is in position, trouble is not yet over, for water-cooling coils are necessary to keep the temperature of the oil below 100° C. Such coils are apt to give a good deal of trouble if the water contains any mineral matter, because sediment is deposited on the inside of the piping, and in some cases has to be removed every day or alternate day. This may be effected by blowing air through the coils and so stirring up the deposit that it runs off with the water. Of course the piping must be arranged for the water to enter and leave at the lowest point, so that everything can be drained away.

In case the water is very bad, an obvious way out of the difficulty is to circulate the oil instead. Thus a small centrifugal pump could force the oil through coils immersed in running water situated outside the transformer case. As natural circulation would do much of the work, quite a small pump would suffice, indeed, one pump could serve several transformers.

It is clear that every care must be taken to keep the temperature of the oil within limits, because if once the flash point is reached, the resulting fire would be disastrous. As a safeguard, many transformers are fitted with a thermostat adjusted to open a closed circuit alarm at 100° C.

Whatever may be the final decision of engineers as to the use of oil in transformers, there seems to be no two opinions as to its being a necessity for extra high tension switches. Practically every station which the members of the Institution of Electrical Engineers saw in the States and Canada was equipped with such oil switches, and certainly the bricked-in switch chamber with keyboard pneumatic or electric control does seem to be the last word in high-tension switchboard design.

Flare switches, so much used on the Continent, are dangerous by comparison, and have the objection of setting up a considerable increase of pressure on the system. Oil on the other hand, shuts down the arc before the pressure has time to rise.

Besides the danger of fire, there is just one other point which may give trouble in countries where cold is extreme; it is that the oil may become thickened. As a cure for this the General Electric Co. recommend mixing tetra-chloride of carbon with the oil.

NEW ELECTRICAL PROJECTS FOR PARLIAMENT TO CONSIDER.

Below we give a list of applications for electrical powers which, unless they fail to survive the preliminary stages, are to be considered during the next Parliamentary session. It is, of course, impossible to give, in these columns, more than the briefest outline of the powers sought; those who require fuller details will be able to examine the same in the last few issues of the *London Gazette*:—

Section I.—Electric Lighting and Power Proposals.

Andover Corporation.—Prov. order.

Aylesbury Gas Light and Coke Co., Ltd.—*Re* electric lighting.

Barnet.—Electric lighting powers for the North Metropolitan Electrical Power Distribution Co., Ltd.

Barton-upon-Irwell.—Lancashire Electric Power Co.; prov. order.

Bolton Corporation.—Further powers regarding electricity; agreements for carrying on other electrical undertakings and supplying electricity thereto; power to refuse to supply electricity to persons whose payments are in arrear, also to refuse supply, or continuance of same, "to any person having a separate supply, unless such person shall have previously agreed to pay such minimum annual sum as may be agreed upon, and, failing agreement, as may be settled by arbitration."

Brentford.—Brentford Electric Supply Co., Ltd. Prov. order.

Brentford.—Metropolitan Electric Supply Co., prov. order.

Bristol Corporation.—Powers to construct sub-stations, transforming stations and other electrical works under streets.

Brockenhurst and Milton (Southampton).—Christy Bros., and Middleton, for prov. order.

Burslem Corporation.—Electric lighting extensions to Urban District of Tunstall

Bury Rural District Council.—Supply electrical energy.

Central Electric Supply Co., Ltd.—Erection of generating station in Marylebone; supply of electricity in Hampstead, Marylebone, Paddington, Westminster, St. Pancras, Holborn, &c.; removal of restrictions under 1899 Act

Charing Cross and Strand Electricity Supply Corporation.—Powers for supply of energy in bulk or for power purposes in London, Essex and Middlesex.

Chelsea Electricity Supply Co.—Extinction of founders' shares and allotment of ordinary in lieu thereof; reduction of capital.

City of London Electric Lighting Co.—Extension of powers to include supply of electricity in portions of counties of London and Kent (the added area consists of that portion of the County of London south of a line drawn along the centre of the bed of the River Thames, and that portion of the county of Kent which is included within a stated boundary line, reaching to the left bank of the River Medway, the Isle of Grain, London Stone, to Hope Point, &c.)

Clewer and Old Windsor.—Windsor Electrical Installation Co., Ltd. Prov. order.

Colne Corporation.—Supply of electricity in Trawden Urban District and other places, for traction and other purposes; purchase of energy in bulk, &c.

Conway Council.—Prov. order.

County of London Electric Supply Co., Ltd.—Compulsory purchase of lands for generating stations in Tottenham, Hackney, Camberwell, Wandsworth, and Finsbury; supply of electricity to undertakers in these and other districts.

Croydon Rural District.—County of London Electric Supply Co., Ltd.; repeal of Mitcham 1901 electric lighting order.

Dorchester.—Prov. order to Dorchester and District Electric Supply Co., Ltd.

Dover Corporation.—Electricity supply in Hougham, Poulton, River, Alkham, and a number of other specified parishes.

Durham Districts.—County of Durham Electrical Power Distribution Co., Ltd., to supply within the rural district of Durham, and part of the rural district of Chester-le-Street.

Ealing Corporation.—Sundry electric lighting powers, also supply of energy to adjoining districts, and for traction purposes; restricting use of overhead wires; supply of fittings.

Eastbourne Corporation.—Extension powers for Willingdon.

East London and Lower Thames Electric Power.—New company to supply in parts of London and Essex, and in West Ham. Many incidental provisions.

Farnham and District Electric Supply Co., Ltd.—Electricity supply for Farnham.

Golborne U.D.C.—Electricity supply.

Gosport and Alverstoke Electric Lighting Co.—Supply of electricity to Urban District of Gosport and Alverstoke.

Gravesend Corporation.—Extension of supply area to include Northfleet. Revocation of the Northfleet 1901 Order.

Great Berkhampstead Gas Light and Coke Co.—Power to supply electricity.

Haydock U.D.C.—Electricity supply.

Hemsworth and District.—Prov. order for Hemsworth Electricity Supply Co., Ltd.

Hessle U.D.C.—Prov. order.

Hessle Gas Light and Coke Co.—Electric lighting powers.

Hipperholme U.D.C.—Electricity supply.

Houghton-le-Spring and District.—Transfer of electric lighting powers (1904) from Sunderland Electric Tramways, Ltd., to another company.

Hythe Corporation.—Agreement with the Folkestone Electricity Supply Co., as to supply of energy for pumping and other waterworks purposes; laying mains therefor, &c.

Kingsbury U.D.C.—Prov. order.

Little Hulton U.D.C.—Electricity supply.

Litchfield.—Foote & Milne, Ltd. Prov. order.

Litherland U.D.C.—Prov. order.

Little Lever U.D.C.—Prov. order.

London.—Administrative County of London and District Electric Power Co. Power to establish stations and supply electricity in Middlesex, Surrey, Essex and Kent, and the Administrative County of London; numerous incidental provisions.

Loughborough Corporation is bringing in a Bill for various purposes, including "powers *to refuse to supply* electrical energy and gas to persons in certain cases."

Lytham.—Foote & Milne, Ltd. Prov. order.

Ludlow.—Wm. Norton. Prov. order.

Marlborough Electric Supply Co., Ltd.—Electric lighting of Marlborough Borough and Urban District.

Macclesfield.—Foote & Milne, Ltd. Prov. order.

Metropolitan Electric Supply Co., Ltd. (Various powers).—Supply of energy in bulk, and for motive power and heating within a very large area including Westminster, Marylebone, St. Pancras, Holborn, Hampstead, Paddington, Kensington, Hammersmith, Chelsea and Fulham in the County of London; Ealing, Acton, Hanwell, and many other places in Middlesex; repeal, alteration and amendment of Acts relating to the company.

Metropolitan Electric Supply Co., Ltd., (for Acton District).—Power to make agreements with Acton U.D.C. for supply of energy.

Morley Corporation.—Extension of generating station; further lighting powers, including laying mains in streets not dedicated to public use, also regarding supply to premises having separate supply, and to provide for consumers giving notice before removing.

North Metropolitan Electric Power Supply Co., Ltd.—Extension of area; agreements with companies and bodies as to mutual supply; supply to Alexandra Palace, and to railways, tramways, &c.

Penmaenmawr U.D.C.—Prov. order.

Portland U.D.C.—Prov. order

Rushdon, Higham Ferrers, Irthlingborough and Thrapston (Rural).—Electricity supply powers to E. P. Harvey, of Riverdale House, Richmond.

Shepton Mallet Gas Co.—Electric lighting powers.

Shropshire and Worcestershire Electric Power Co.—Provisions as to alteration and extension of area, and transfer of and application for prov. orders; financial provisions.

Southall—Norwood U.D.C.—Prov. order.

Southall—Norwood.—Application by Metropolitan Electric Supply Co. for electric lighting prov. order.

Southend-on-Sea Corporation.—Enlargement of electricity works; powers to supply outside the borough and to sell and hire motors, fittings, &c., and exempt hired fittings from being taken in execution or bankruptcy proceedings; alteration of financial year; provisions to refuse supply if payments are in arrear, and to deal with consumers who have separate supply.

South Wales Electrical Power Distribution Co.—Transfer to this company of the Carmarthenshire Electric Power Co.'s undertaking, extension of whose area of supply is applied for so as to include Llanelly; extension of time thereunder.

Spalding U.D.C.—Prov. order.

St. Albans and District Electric Supply Co., Ltd.—Power to supply rural district.

Stratford-upon-Avon Corporation.—Amendment of 1901 prov. order; extension of time and transfer powers.

Surbiton U.D.C.—Prov. order.

Tewkesbury Corporation.—Electricity supply.

Tewkesbury.—Fourd Ely, prov. order.

Tottington.—Application for prov. order by Lancashire Electric Power Co.

Wanstead.—Empire Electric Light and Power Co., Ltd. Prov. order.

Ware.—North Metropolitan Electrical Power Distribution Co. for prov order; also repeal of the 1901 Lighting Order.

Weybridge and Walton-on-Thames.—Urban Electric Supply Co., Ltd.

Whitwood U.D.C.—Electric lighting powers.

Whitby U.D.C.—Hiring and dealing in electric motors, apparatus and fittings, which shall be exempt from distress or seizure under process of law.

Whitworth U.D.C.—Electric lighting order.

Wimborne and District.—Bournemouth and Poole Electricity Supply Co., Ltd., seeks powers to supply electricity.

Woking Electric Supply Co., Ltd.—Supply powers for Chertsey, Byfleet, Pyrford, Chobham and Bisley.

Woolwich Council.—Prov. order; amendment of existing orders. Incidental powers.

Woolwich Borough Council.—Agreements with other local authorities as to supply of electricity in bulk or otherwise. Powers to modify obligations of the Corporation respecting consumers who have separate supply.

Section II.—Tramway and Light Railway Powers.

Accrington Corporation.—Tramway powers.

Aberdare U.D.C.—Tramways, electricity works, and refuse destructor.

Aberavon.—Application by a company for powers to construct tramways in Aberavon and Margam.

Bath Electric Tramways, Ltd.—Light railways extensions.

Bideford, Clovelly, and Hartland Light Railways.—(Western Counties Light Railways Co., Ltd.).

Birmingham Corporation.—New tramways in King's Norton and Yardley.

Blackpool Corporation.—New electric sections; amendment of various lighting and tramway Acts, and other powers.

Blackpool, St. Annes and Lytham Tramways Co.—Powers to run over and use compulsorily certain tramways of the Blackpool Corporation.

Blyton and Frodingham Light Railway (15 miles)—Application by Lindsey Light Railway Syndicate for an order.

Bradford Corporation.—Tramway powers for Hipperholme.

Buenos Ayres Grand National Tramways Co., Ltd.—Amalgamation with another company and various financial provisions.

Bury Corporation.—Powers to construct, &c., electric tramways; alteration of Ramsbottom and Radcliffe U.D.C.'s tramway powers

Colchester Corporation.—Tramway extension.

Croydon Corporation.—New tramways in the county borough and in Penge; supply of electricity in bulk to outside boroughs or companies; taking over prov. orders from outside authorities.

Coventry Electric Tramways Co.—Extension of period under 1903 Act, reconstruction of some existing lines, &c.

East Sussex Light Railway.—Extension of time.

Gorton U.D.C.—Tramway powers.

Gosport and Fareham.—Portsmouth Street Tramways Co., additional lines; extension of time; abandonment of part, &c.

Hastings Tramways Co.—Construction of tramways in Bexhill; provision as to purchase; extension of time and removal of restrictions.

Halifax Corporation.—Construction of tramways in the West Riding; "exemption of Corporation from payment of local rates in respect of tramways outside the borough."

Keighley Corporation.—Tramways as specified.

King's Norton and Northfield.—Tramway powers.

Knutsford and Warrington Light Railways.—Application by the Cheshire Light Railways, Ltd., for an order.

Leeds Corporation.—New tramways in Armley and Bramley.

Liverpool Corporation.—New tramways.

Liverpool Corporation.—Further tramway powers.

London County Council.—New tramways in the cities of London, Westminster, and in Lambeth, Southwark, Lewisham and Camberwell; abandonment of part of authorised tramway and subway; extension of time for authorised lines, &c.

London Southern Tramways Co.—Powers to work electric generating stations; land purchase; postponement of purchase by L.C.C.

London United Tramways (1901), Ltd.—Amendment of 1901 and 1902 Acts, including extension of time thereunder.

Luton Corporation.—Electric tramway powers.

Maidstone Corporation.—Light railways (extensions).

Mansfield and District Light Railways Co. is seeking powers for extensions of authorised railways in the County of Nottingham.

Metropolitan Electric Tramways, Ltd.—Street widenings, land purchase, agreements with companies as to supply of electricity; postponement of purchase by local authorities.

Mexborough and Swinton Tramways Co.—Extension of time under 1902 Tramways Order and under Rawmarsh and Swinton Electric Lighting Order; amendment of Acts.

Newark and District Light Railways.—New company. Provisional order for electric lines, agreements for supplying electricity to other companies, &c.

Nottingham Corporation.—New electric tramways, and other various powers, including declining to supply electricity to any person in arrears.

Oldham and Saddleworth District Tramways Co.—New tramroad in Mossley and Springhead, and power to Stalybridge, Hyde, Mossley, &c., Tramways and Electricity Board to construct same. Extension of time under certain Tramway Acts

Portmadoc, Beddgelert and South Snowdon Railway Co.—Light electric railways.

Pudsey Corporation.—Electric tramways.

Rhondda U.D.C.—Tramways extension, &c.

Southampton Corporation.—Tramways extensions.

Southend and Colchester Light Railways Co., Ltd.—Light railways scheme.

South Lancashire Tramways Co.—Extension of time, abandonment of certain lines, re-arrangement of capital; transfer to this company of the Lancashire Light Railway Co., Ltd., and the generating station and other assets of the South Lancashire Electric Traction and Power Co., Ltd., also agreements with liquidators of the latter company.

Swansea Corporation.—Acquisition of the tramways undertaking of the Swansea Improvements and Tramways Co.

Tyneside Tramways and Tramroads Co., Ltd.—Power to issue preference capital.

Wellingborough and District Tramroads and Electricity Supply.—Extension of time powers for some, and abandonment of other lines; agreement with authorities in the counties of Northampton, Bedford and Huntingdon for electricity supply.

West Cumberland Electric Tramways Co. is applying for extension of time for commencing construction of its authorised tramways, amendment of Acts and various other powers.

Wigan Corporation.—New tramways in Wigan, Upholland, Orrell and Aspull; supply of electricity outside borough; transfer to Corporation of certain tramways or powers under South Lancashire Tramways Acts of 1900 to 1903 (the tramways of the Urban Districts of Haydock, Ashton-in-Makerfield, Abram, Ince-in-Makerfield, Hindley, Atherton, and Golborne are mentioned.)

Section III.—Electric Railway Schemes.

Baker Street and Waterloo Railway Co.—New subways, abandonment of authorised ditto, land, extension of time and other powers.

Central London Railway.—(New lines)—Shepherd's Bush, Uxbridge Road, Leadenhall Street, E.C., Old Broad Street; also various subways

Charing Cross, Euston and Hampstead Railway.—Various powers as to lands, arrangements with other companies, application of capital amendment of Acts, &c.

Cork Grand Junction Railways.—New company to construct electric lines, obtaining electricity from Cork Electric Tramways Co., Ltd.

Edgware and Hampstead Railway Co.—Deviation, abandonment of portion, extension of time, agreements with other railways and the Underground Electric Railways Co. of London; payment of interest during construction, &c.

Great Northern, Piccadilly and Brompton Railway (No. 1).—New lines, extension from Kingsway to Waterloo, abandonment of parts, land and other powers, including agreements as to electricity supply with Metropolitan District and Underground Electric Railways Co., of London.

Great Northern, Piccadilly and Brompton Railway (No. 2).—New lines Shepherd's Bush Common; agreements with other railway companies as to same, &c.

Hammersmith, City and North-East London Railway Co.—Electric railways from Hammersmith to Palmer's Green and Walthamstow.

Metropolitan District Railway Co.—Financial powers.

Metropolitan Railway.—Transfer of Harrow and Uxbridge Railway Co. to this company; capital powers.

North-East London Railway Co.—Electric railways from Eastcheap to Shoreditch, Waltham Cross, Cheshunt, Low Leyton, &c.; generating stations; agreements with Metropolitan and District Railways, Underground Electric Railways Co. of London, Ltd., City and South London, Central London and other companies.

Whitechapel and Bow Railway Co.—Powers as to agreements with the District Railway Co. and the Underground Electric Railways Co. of London, Ltd, as to obtaining supply of electricity for working the Whitechapel and the London, Tilbury and Southend Railways,

Section IV.—Miscellaneous.

London County Council (General Powers).—Supply of electric fittings by Councils of metropolitan boroughs.

Metropolitan Pneumatic Despatch Co.—Establishment of pneumatic transport; construction of tubes, cables, and works; generation and application of electric power; powers to transmit parcels within and beyond London.

University College, London.—Transfer of to University of London.

Weaver Navigation.—Alteration of lifts at Anderton, and electrical working of same.

NEW PATENTS APPLIED FOR.

Compiled expressly for this Journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

24,599. "Improvements in guards or shields applicable for electric incandescent lamps." J. Devitt and C. Maskrey. November 14th.

24,605. "Improvements in or relating to wattmeters." W. E. Sumpner. November 14th.

24,618. "X-ray obstructing material." W. M. Martin. November 14th.

24,620. "Electric clocks and the like." I. H. Parsons and A. E. J. Ball. November 14th.

24,627. "Improvements in subscriber's call signalling devices for telephone exchange systems." J. Macfee. November 14th.

24,632. "Improvements in electrically-operated switches." A. Eckstein and E. Parker. November 14th.

24,660. "Improvements in gas and electric lamps or fittings." G. A. Walker. November 14th.

24,668. "Improvements in electrical valve controlling systems." I. G. Waterman. November 14th. (Complete.)

24,675. "Improvements in electric brakes for trams and other vehicles." R. B. Ransford. (The American Electric Brake Co., United States.) November 14th. (Complete.)

24,689. "Improvements in and relating to electric storage batteries." L. N. J. Rosellé. November 14th. (Date applied for under Patents Act, 1901, November 16th, 1903, being date of application in France.) (Complete.)

24,692. "Improvements in means for ascertaining the power factor in alternating current systems." A. Grammont. November 14th. (Date applied for under Patents Act, 1901, November 24th, 1903, being date of application in France.) (Complete.)

24,698. "Improvements in electric switches." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) November 14th.

24,699. "Improvements in electric motor control and apparatus therefor." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) November 14th.

24,700. "Improvements in systems of electric motor control and in apparatus therefor." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) November 14th.

24,701. "Improvements in electric motor control and in apparatus therefor." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) November 14th.

24,708. "Improvements in the control of electrically-propelled vehicles." C. W. G. Little. November 14th.

24,710. "Improvements in or connected with coin-freed games of skill and apparatus for administrating electric current." J. H. Gibb. November 15th.

24,715. "Improvements in incandescent gas and electric globe lamps." J. W. Lea and J. H. Perrins. November 15th. (Complete.)

24,729. "Improvements in electric tramcars and the like, and in lifeguards or obstruction removers for use therewith." W. Whittaker. November 15th. (Complete.)

24,732. "Improvements relating to inverted incandescent gas lamps." M. Hay. November 15th.

24,769. "Improvements in or connected with electrical commutators." Nalder Bros. & Thompson, Ltd., F. H. Nalder and O. Cox. November 15th.

24,770. "Improvements in electric signalling devices for elevators or the like." O. Imray. (F. S. Payne, United States.) November 15th. (Complete.)

24,788. "Improvements in electric arc lamps." W. R. Whitney. (Date applied for under Patents Act, 1901, November 16th, 1903, being date of application in United States.) November 15th. (Complete.)

24,828. "Improvements in apparatus for raising and lowering electric arc lamps." W. F. Mason. November 16th.

24,831. "Improvements in apparatus for actuating the points in electric tramway systems." E. Rothwell. November 16th.

24,850. "Improvements in instruments for detecting and measuring alternating electric currents." J. A. Fleming. November 16th.

24,857. "Improvements in electricity meters." C. A. A. Capito. November 16th.

24,873. "Improvements in or connected with regulating arc lamps." J. Brockie. November 16th.

24,874. "Improvements in and relating to alternating current electric generators." The British Thomson-Houston Co., Ltd. (The General Electric Co. United States.) November 16th.

24,875. "Improvements in controlling apparatus for electric motors." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) November 16th.

24,876. "Improvements in and relating to electro-magnetic speed changing and reversing devices." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) November 16th.

24,900. "Improvements in electrical breaks or interrupters, and means for operating the same." A. L. Davis. November 16th.

24,915. "Improvements in or relating to methods of insulating coils and the like, especially applicable to the construction of high-tension electrical machinery." J. S. Highfield. November 16th.

24,918. "Improvements in the manufacture of leading-in wires for incandescent electric lamps or other vessels requiring leading-in wires with gas-tight joints." A. C. Hyde. November 17th.

24,927. "Switches for electric railways and tramways." A. Marshall. November 17th.

24,951. "A new or improved medical electric and magnetic appliance." T. Cooke and J. R. Cooke. November 17th. (Complete.)

24,955. "Improved ironing machine with electrically-controlled pressure." A. E. Hacking and J. Pycroft. November 17th.

25,010. "Improved process for producing nitric acid by aid of electricity." Westdeutsche Thomasphosphat-Werke Gesellshaft mit Beschrankter Haftung. (Date applied for under Patents Act, 1901, October 19th, 1904, being date of application in Germany.) November 17th. (Complete).

25,026. "Improvements in and relating to electric switch operating mechanism." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) November 17th.

25,027. "Improvements in and relating to electric switch operating mechanism." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) November 17th.

25,029. "Improvements in potentiometer apparatus for localising the position of faults in electric wires and cables." T. Moore. November 18th.

25,041. "Improvement in trolley-heads in connection with electrical tramways on the overhead wire system." W. Kneen. November 18th.

25,072. "Improvements in terminals for use in electric main and other switches." J. R. Craig, Jun. November 18th.

25,078. "Improvements in electric ignition devices." E. Aron (trading as the Continental Hardware and Cycle Co). (L. Boulez, France.) November 18th. (Complete.)

25,095. "Improvements in electric accumulators." E. W. Jungner. November 18th. (Complete.)

25,105. "Improved device for distinguishing between the poles of an electric circuit." H. G. Prested. November 18th. (Complete.)

25,106. "Improved apparatus for regulating the current through an electric lighting circuit." H. G. Prested. November 18th. (Complete.)

25,112. "Improvements relating to electric light systems." H. H. Lake. (C. A. Gould, United States.) November 18th. (Complete.)

25,114. "Improvements in electric accumulators." J. M. de la Croix and H. F. Joel. November 18th. (Complete.)

25,128. "An improved fireproof, acid-proof and electrically insulating material." U. Maga. November 18th. (Complete.)

25,129. "Improvements in electric braking apparatus." W. P. Thompson (L. Staam & E. D. Lewis, United States). November 18th. (Complete.)

25,171. "Improvements in electric light baths and the like radiant therapeutic appliances." J. Scott. November 19th.

25,172. "Improvements in dynamo-electric machinery." S. T. Webster. November 19th.

25,175. "Improved electrical apparatus for timing the speed of motor-cars or other vehicles over measured distances." G. Higginbotham. November 19th.

25,181. "An improvement in and relating to electric lamps." C. P. J. Fitzsimon. November 19th.

25,189. "An improved composition for electrical conduits." R. Starke. November 19th.

25,194. "Application of a coherer to any electric transmission by means of conductors for any distance for telegraphic, telephonic signalling bell or other systems." G. Magini. November 19th.

25,196. "Improvements in means for improving the power factor of alternating current circuits." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) November 19th.

25,218. "An enclosed electro-magnet." D. Perret. (Date applied for under Patents Act, 1901, March 12th, 1904, being date of application in Switzerland.) November 19th. (Complete.)

25,219. "Improvements in protective systems for electric distribution lines." L. Wilson. (Date applied for under Patents Act, 1901, November 20th, 1903, being date of application in United States.) November 19th. (Complete.)

25,220. "Improvements in protective systems for electric distribution lines." L. Wilson. (Date applied for under Patents Act, 1901, November 20th, 1903, being date of application in United States.) November 19th. (Complete.)

24,744. "Electrical time-keeper and alarm clock." H. F. Schmidt. November 15th.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

Dynamo-Electric Machines. E. A. Carolan. (The General Electric Co., United States.) 22,912. October 22nd.

Welding by Electricity and Apparatus Thebefor. J. Harmatta. 22,981. October 23rd.

Protecting Devices for Parallel Feeders Used in the Distribution of Electrical Energy. L. Wilson. 23,173. October 26th.

Dynamo-Electric Generators and Motors. A. D. Jones and the Jandus Arc Lamp and Electric Co., Ltd. 23,192. October 27th.

Sparking Plugs and the like for Electric Ignition. F. H. de Veuille. 23,359. October 28th.

Electric Resistance Boxes. A. H. Adams and A. H. Curtis. 23,540. October 30th.

Telephone Mouthpiece or Receiver. R. B. Cruickshank. 23,516. October 30th.

Raising and Lowering Electric Arc Lamps. W. A. Brown. 23,636. October 31st.

Method of and Means for Starting and Braking Electric Motors. Siemens Bros. & Co. 23,664. October 31st.

Galvanic Batteries. The Halsey Electric Generator Co., Ltd. (The Halsey Electric Generator Co., United States.) 23,767. November 2nd.

Electric Cranes. Stothert & Pitt, Ltd., and W. Pitt. 23,851. November 3rd.

Electric Log Recording and like Apparatus. H. von Kohler. 23,862. November 3rd.

Electric Distribution System. J. H. Hallberg. 23,863. November 3rd.

Regulating Means for Mercury Vapour or like Electric Lamps. H. C. Levis. 24,142. November 6th.

Electric Switch with Indicator. The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) 24,283. November 9th.